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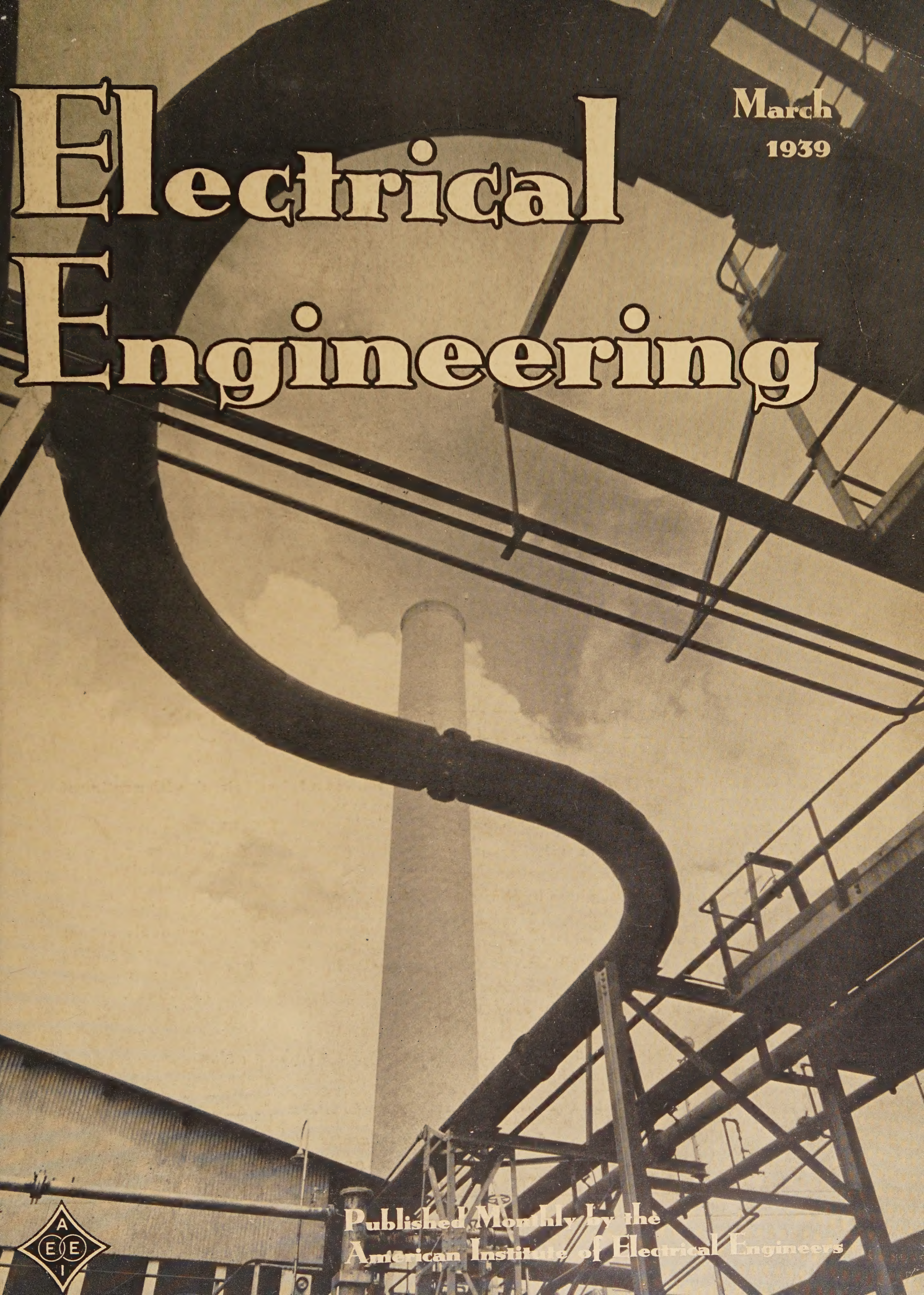

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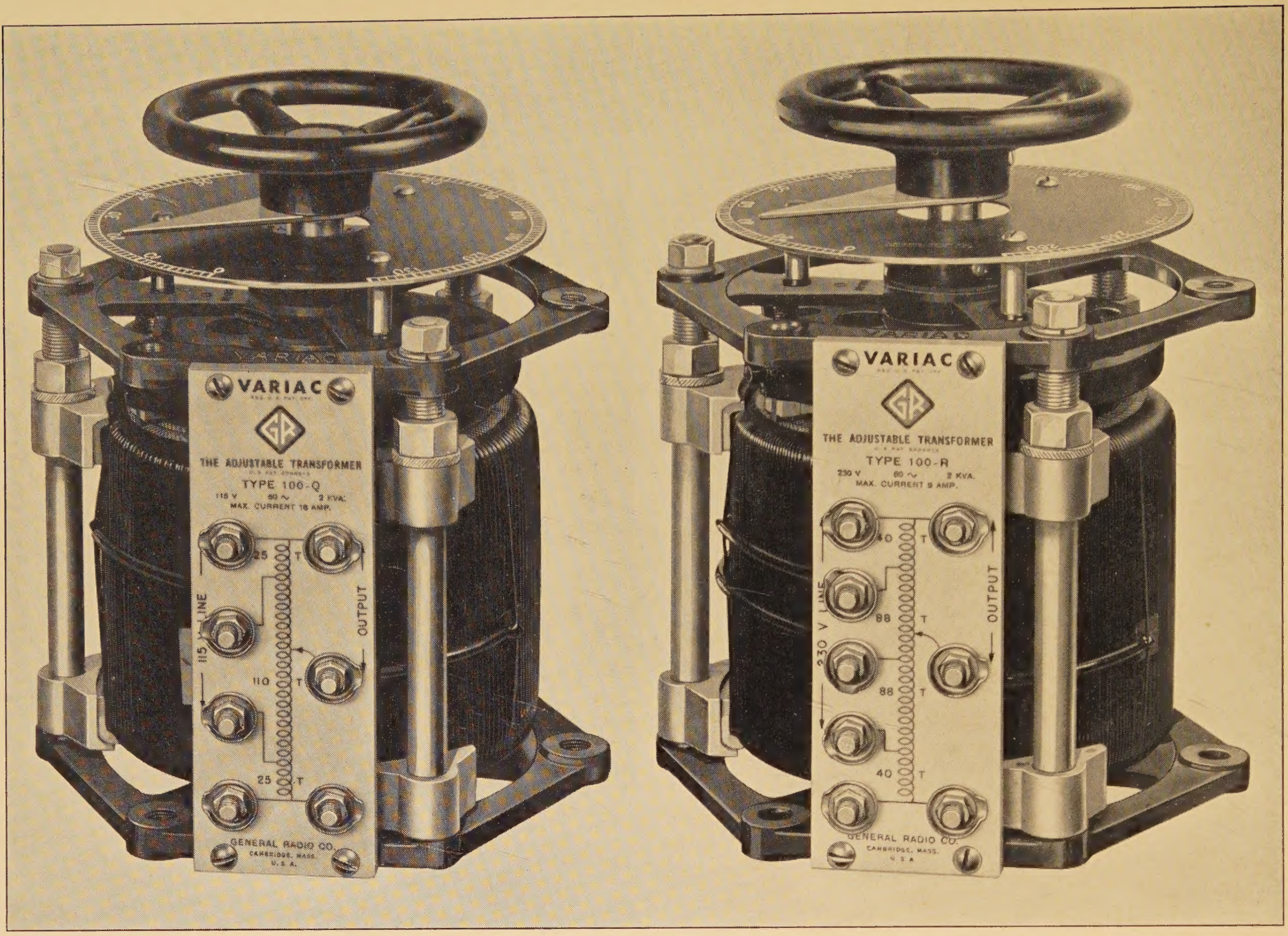

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Electrical Engineering

Registered U. S. Patent Office

for March 1939—

The Cover: A view in an eastern Texas oil refinery; some phases of the oil industry will be discussed at the AIEE South West District meeting in Houston, Tex., April 17–19, 1939

Photo by Robert Yarnall Richie

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¶ Correspondence is invited on all controversial matters.

High Lights

Hurricane Experiences. On September 21, 1938, the first major hurricane in that territory for more than a century swept across Long Island, N. Y., and parts of the New England states, leaving a trail of devastation in its path. Some 500 people were killed, and 2,000 injured; property damage is said to have been the greatest that has been caused by any disaster of historic times in America; public utilities, which play so vital a role in modern life, were incapacitated. With a view to determining any engineering conclusions that might be drawn from the experiences following the hurricane, one general session of the recent AIEE winter convention was devoted entirely to a discussion of the general damage caused by the storm (*pages 99–101*) and of its effects on the railroads (*pages 102–04*) the power utilities (*pages 105–10*) and the telephone systems (*pages 111–12*).

Rectifiers. Research since the introduction of the copper-oxide type of rectifier in 1927 has broadened the possibilities for its application beyond its uses for battery charging and as a valve in control circuits. By spraying a conducting coating on the copper oxide, rectifiers may be constructed from plates considerably larger than the usual disks, and the ratings increased to values suitable for electrochemical applications (*Transactions pages 103–06*).

Interconnection Control. Automatic control has been applied to an interconnection between power systems to enable the maximum transfer of energy without separation of the systems. By means of carrier current a continuous indication of the phase-angle difference between the systems is obtained, and the output of generating units at the control station regulated automatically to maintain the angle within desired limits (*Transactions pages 83–93*).

Colorado River Aqueduct. Boulder Dam power plant ultimately will supply 300,000 kw to operate pumps for an aqueduct bringing 1,500 second feet of water from the Colorado River to southern California. A description of the 220-million-dollar project, including the electrical equipment and transmission system for the five pumping stations, is given in this issue (*Transactions pages 112–23*).

Power Limits. Static power limits of synchronous machines may be determined accurately by an analysis in which resistance, shunt loads, salient poles, and saturation are considered, and which by application to operating systems may indicate changes in load dispatching that would result in higher power limits and increased reliability (*Transactions pages 93–102*).

Image Transmission. Line images such as drawings, diagrams, and animated cartoons may be transmitted by a system which requires a frequency band not exceeding 10,000 cycles in width and hence could be accomodated on telephone lines with suitable modification. Reproduction is by means of a cathode-ray tube; simplification is obtained by omitting the transmission of blank areas (*Transactions pages 124–7*).

District Meetings. A program of technical sessions on varied subjects and entertainment features has been announced for the AIEE South West District meeting at Houston, Tex., April 17–19, 1939 (*pages 129–30*). Plans are nearing completion for the North Eastern District meeting to be held at Springfield, Mass., May 3–5, 1939 (*pages 130–1*).

Ferroresonant Circuits. Application of the principle of similitude to the generalization of ferroresonant circuits offers a simple solution for the critical conditions, and enables the critical stable conditions of any reactor to be predetermined from those of a known reactor using the same grade of iron (*Transactions pages 127–30*).

Nominations for AIEE Offices. The Institute's national nominating committee met during winter-convention week to designate nominees for election to Institute offices for the year 1939–40 (*pages 128–9*). Biographical sketches of the nominees are included in the "Personals" section of this issue (*pages 134–6*).

Winter Convention. Registered attendance at the 1939 AIEE winter convention was the highest since 1924. The program included 17 technical sessions, 2 general sessions, 5 technical conferences, presentation of both the Edison and John Fritz medals, and the usual entertainment events and inspection trips (*pages 123–8*).

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Postgraduate Courses. A study of engineering education as a whole seems to be needed to point to the best way to give graduate training and to fix the graduate curricula. The necessity and usefulness of ordinary present-day graduate courses are seriously challenged (*pages 118–22*).

Petersen Coils. Excessive currents may flow in Petersen coils on systems in which the capacitances to ground of the transmission-line conductors are unbalanced. These undesirable circulating currents may be reduced by rearrangement of the circuits (*Transactions pages 107–12*).

Social Participation. Engineers wishing to participate in matters pertaining to social philosophy might do so through groups organized for social, economic, or political purposes to better advantage than through professional technical societies (*pages 113–14*).

John Fritz Medalist. At the recent AIEE winter convention the 1939 John Fritz Gold Medal was presented to a prominent Institute member whose biography indicates his eminent qualifications for this honor (*pages 115–17*).

Bylaw Amendment. Among actions taken at a recent meeting of the AIEE board of directors was the amendment of a section of the bylaws pertaining to technical papers (*pages 131–2*).

Coming Soon. Among special articles and technical papers undergoing preparation for early publication are: an article outlining the qualities of a profession by Vannevar Bush (F'24); an article on the definition of engineering experience by C. F. Scott (HM'29); contributed discussions of the article "Graduate Training for Engineers" which appears in this issue; an article describing gearmotors and some of their applications; a paper on the reconditioning of insulating oils by activated alumina by J. E. Housley (A'19); a paper on generator damper windings at Wilson Dam by R. B. George (M'27) and B. B. Bessesen (M'27); and a symposium on operation of the Boulder Dam transmission line, consisting of papers on the general operation of the line by W. S. Peterson (M'29), insulation and lightning protection by Bradley Cozzens (A'28), corona experience by these two authors jointly, carrier-current equipment by J. D. Laughlin (A'36), and relay protection by L. L. Draper (A'29).

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Experiences From the New England Hurricane

With a wind velocity as high as 186 miles per hour, and traveling forward as fast as 65 miles per hour, the hurricane that devastated parts of Long Island and New England on September 21, 1938, was the first storm of its character to afflict this territory in more than a century. The storm originated at least ten days prior to that time in the Caribbean Sea and was expected to strike the city of Miami, Fla., but turned north instead; later, it veered unexpectedly to the west as it progressed northward, gaining in intensity and momentum, and with unpredictable fury swept across a territory where a hurricane of any sort is a rarity. The story of the terrible destruction and loss of life left in its wake already has been told, as has been the story of the tremendous damage to the various public-utility systems and the added suffering resulting from the temporary loss of these services. With a view to determining what if any engineering conclusions might be drawn from the experiences following the hurricane that might be of value in the future, one of the two general sessions of the AIEE 1939 winter convention was devoted to a presentation and discussion of six addresses on this subject. The following six articles embrace the essential substance of those six addresses.

I—General Review of the Storm and Its Effects

By WALTER WESSELIUS

THE Red Cross operates in many, many disasters—on an average of a hundred per year—and this last year was no exception. In fact, during the past year, domestically we handled through the national organization and its chapters 129 disasters divided between floods, cloudbursts, epidemics, tornadoes, and miscellaneous other types of disasters.

Some disasters are predictable and others are not. Among those on which we have and can get advance information are, of course, floods and hurricanes. Over the past many years, the Red Cross has developed very intimate functional and co-operative relations with many departments of the government, and our relations with the Weather Bureau have been exceedingly close.

In the instance of the storm which finally hit New England on September 21, 1938, we had been apprized by the Weather Bureau in Washington at least ten days previously that a tropical disturbance was in the making way out in the Caribbean and that it seemed to assume the proportions of a hurricane. From that time on, we obtained from the Weather Bureau at three-hour intervals specific information as to that storm, the degree of intensity as the indications pointed, the direction, and other factors which would prove helpful to us in formulating our plans. For a period of several days, we marked our map, with the pins set at regular intervals; the storm was traveling straight as a die and, if carried on, would have finally hit the city of Miami, Fla. It seemed then certain that it would, although the Weather Bureau cannot, of course, and will not, advisedly, state that a storm will hit any point until it is reasonably close. In the meantime, the machinery of the Red Cross was put into operation. Every chapter in the state of Florida was advised of the storm coming and that further information would be given as it became available.

We set in operation certain mechanics of insuring communications by radio if and when communication was disrupted, as it usually is in a hurricane. We tightened our lines with respect to the evacuation of known hazardous areas, particularly the Lake Okeechobee area, through our relations with the Florida East Coast, the Atlantic Coast Line, and other railroads, so that that area could be immediately evacuated. We had our personnel on the trains actually on the way. We were ready to co-operate with the local leadership, those who comprised our voluntary chapter organizations for dealing with disastrous situations. Our staff had reached Jacksonville, but during the night word had been received in Washington that the storm had veered directly north, slightly to the west. We were able to recall our people from Jacksonville, and I was reasonably certain that the storm would not hit either Florida or the North Atlantic Coast.

As I recall the reports, it passed about 100 miles to the east of Cape Hatteras, N. C. It is axiomatic in observation of hurricanes that once a hurricane turns, it stays turned. Certainly a perusal of the record of hurricanes over the

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Essential substance of an address presented at a general session of the AIEE winter convention, New York, N. Y., January 23–27, 1939.

WALTER WESSELIUS is assistant director of disaster relief, National Red Cross, Washington, D. C.

last 50 years supports that statement in a very general way.

Storm Departed From Usual Course

A hurricane, as is quite generally known, is a large tropical disturbance which may have a circumference or a diameter of 50 to 200 miles; ordinarily, it travels forward from 14 to 15 miles per hour, with its wind blowing counterclockwise from 75 to 200 miles an hour. At this rate, the 1938 storm would not have hit the New England coast for days, and, of course, there was no expectancy that it would ever hit there. In fact, we never think of hurricanes in connection with New England like we do with Florida, Cuba, Mexico, Louisiana, and other points in the South. But in this instance, history repeated itself. Records show that on September 23, 1815, a hurricane of similar size and intensity struck New England, and Providence, R. I., was inundated practically to the same degree as it was in the circumstances of last fall.

The storm seemed to have gained a tremendous momentum. I have seen no official statistics but I have heard reports that it traveled forward as fast as 55 to 65 miles per hour. We were watchful at national headquarters, awaiting reports. The first information that came to us was of a high wind at the Floyd Bennet Field. About an hour or two later, our field representative at Providence, mindful of the gale warnings, phoned that water was beginning to come into the city. In fact, it was already quite deep and a serious situation seemed to be developing. Directly after that, communications went out.

Within the next hour we had communication by way of amateur radio from Westerly, R. I., transmitting a message from our chapter chairman there: "For God's sake, send some help. Hundreds are drowning. Send boats. We need boats." We immediately transmitted that information to the Coast Guard station at New London, Conn., through the Washington office of the Coast Guard.

A little later reports came by way of short-wave amateur radio that the entire city of New London was burning. I left the same evening for New London and other members of our staff went forth to cover the various major points which were reported to us, and our communications went out to every one of our 194 chapters within the affected territory. Communication lines were down everywhere. It was very difficult to keep in communication, to ascertain exactly what happened; in fact, it was several days before we could report the degree of the loss of life and property and the relief measures that would be necessary.

The area affected by this storm comprised all of Long Island, Block Island, Fishers Island, and all of the State of Connecticut, all of Massachusetts, all of Rhode Island, and approximately half of New Hampshire and Vermont.

There is another situation with respect to this storm that was rather unique in our experience in that it was a disaster upon a disaster. There was a fire disaster at New London which, fortunately, was restricted to a relatively small part of the business district; but coincident with the hurricane, we were dealing with a flood situation along the Merrimac and Connecticut Rivers. These rivers were in flood in the Norwich area, in New London County, and at Hartford, Conn., and north of Hartford at Springfield and Chicopee, Mass.; the rivers in Central Massachusetts were all in flood at the same time. About 12,000 persons were then being cared for as refugees. The hurricane, of course, complicated the situation and made relief measures much more difficult, taxing the volunteer effort of our chapter people of the Red Cross who were dealing with this matter.

Some Damage Statistics

A few rough statistics concerning the damage done by the storm may be of interest. Approximately 500 persons were killed in New England, and about 2,000 injured; 2,000 year-round residences were destroyed, and about 45,000 homes damaged. I think it is a safe statement to say that nearly all homes in New England were affected to some degree in this hurricane from a few shingles to total destruction. Summer homes represented a major loss with about 7,000 totally destroyed, and about 8,000 damaged. Incidentally, it was in the summer homes where the great loss of life occurred. There was not the warning to New England which was available when the known facts of the storm were brought to our attention, where the storm first originated, namely, in Florida. Consequently, there were no preparatory measures, no warnings, nothing that could be done about it. The storm came on suddenly and did not follow the known characteristics of hurricanes.

About 2,500 barns were destroyed and about 6,000 damaged; other buildings, shacks, sheds, garages, outbuildings —7,500 destroyed, and an estimated 16,000 damaged. There was also great loss in animals—livestock on farms—475 work animals, 1,000 cattle, 200 hogs, and from 500,000 to 750,000 poultry.

Another phase of loss which was brought to our attention as a major consideration in our relief work later was that pertaining to the boat and fishing industry. New England has a great fishing business. Thousands of fishermen earn their whole livelihood in that manner. Following the storm, boats literally were scattered everywhere along the coast. It is estimated that 3,500 boats, from the small type to the largest, were either sunk, beached, ruined, or damaged, and an unlimited number of lobster pots and fishing paraphernalia necessary to the livelihood of these people.

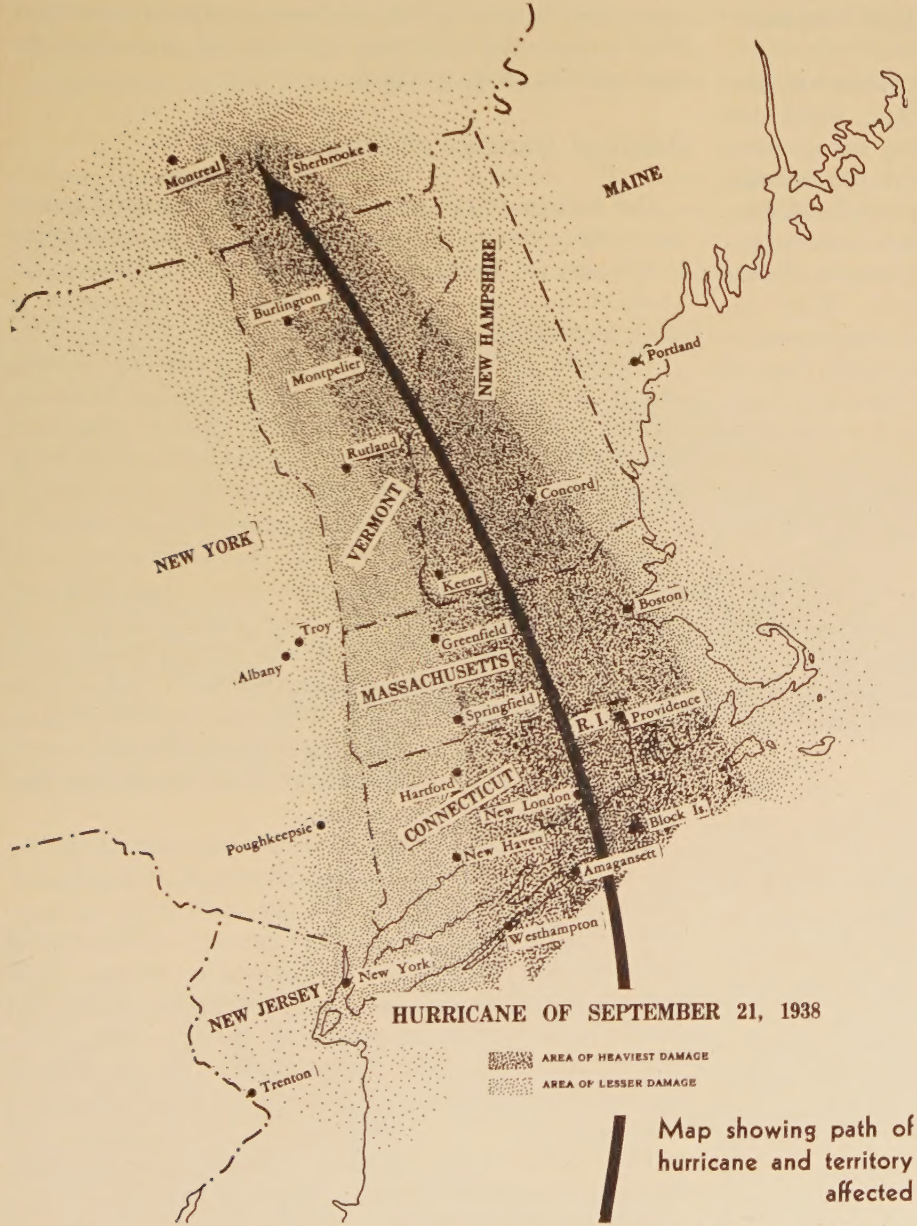
Another serious loss is that pertaining to the terrific loss of trees. Everywhere these beautiful trees of 100 to 200 years of age were scattered right and left—pushed over like toothpicks.

Responsibilities of Red Cross

At this juncture it might be well to say a few words about a question on which there is often many questions—the respective responsibilities of government and of the Red Cross. The Red Cross has a fundamental responsibility imposed upon it by the charter given to it by the Congress of the United States many years ago to deal with the needs of families who have suffered as a result of disaster. Quoting from the charter: "The Red Cross shall mitigate the sufferings caused by fire, flood, pestilence, and other diseases," and so forth, "and shall take steps for the prevention of same."

In disaster relief, government—city, county, state, and federal—has responsibilities of its own to carry out and these responsibilities correlate with those of the Red Cross in many ways. The Red Cross meets human needs, providing food, shelter, clothing, and medical aid, both at home and in shelters.

The correlated responsibility of government in disaster situations is the maintenance of law and order, the prevention of looting, the fundamental responsibility of government in the prevention of epidemic, communicable disease, control of communicable diseases, maintenance of public health, sanitation, and related there again is the question of caring for the dead which is imposed by law as a responsibility of the coroner.



Map showing path of hurricane and territory affected

Although prepared to show severity of damage to telephone plant, this map is believed to indicate with reasonable accuracy the severity of damage to other utility systems and to other structures in general

Courtesy *Bell Telephone Quarterly*

Then there is the other side of the question. The Red Cross has the duty of rescuing people, bringing them to safe shelters and taking care of them until they can be returned to their home, if there is one, or until one has been prepared for them.

Now we can take care of people voluntarily but we do not have the power by law for forceful evacuation. There, again, we work hand in hand with government. If there is enforced evacuation, it is up to the public authorities to do it.

The Red Cross has the responsibility to provide family by family that which they need on a minimum basis which they could not provide themselves from their own resources, either potential or liquid. Thus we have the responsibility in the rehabilitation of families to provide those essentials necessary to bring those people back to a normal self-sustaining basis. That does not mean that we are supplying their losses.

We provide maintenance for those families until they can be cared for under their own resources, aiding them in the building of their homes, furnishing household goods, hospitalization where necessary, nursing care where necessary, farm supplies, livestock and equipment, and occupational assistance. On the other side, government with the 75 or 85 million dollars it made available, had the tremendous task of removal of trees from the highways and the byways, the repairing of bridges, sewer systems, water systems, and other public projects.

Of the 50 or more thousand families affected by this disaster, the Red Cross had applications from 18,935 families, of which 14,300 have been given assistance. We spent $800,000 on building and repair; $25,000 on medical care and nursing; $150,000 in occupational rehabilitation, chickens, repair of boats, and reestablishment of people in the one-man type of business; $200,000 in household goods.

Let it be said here that were it not for the marvelous ingenuity and self-help of the people of New England, we would never have completed this operation within a total sum of $1,700,000. It might easily have gone on to millions and millions. The self-help of these people in caring for themselves in so far as possible and in assuming credit where they had credit was one of the major factors not only for the speedy operation but for its minimum cost.

II—Hurricane Experiences of the Railroads

By SIDNEY WITHINGTON
FELLOW AIEE

THE railroad appurtenances chiefly affected by the storms were: tracks, bridges, passenger and freight station buildings, signals, electric power generating, transmission, and distribution facilities, communication lines, and miscellaneous motors, such as shop, pump, float-bridge and track-switch motors, and drawbridge motors and control circuits. Various types of buildings, boats of all sizes, including a large lighthouse tender which required 17 days to remove, and other debris of all kinds deposited on the tracks, contributed relatively minor but still important problems in restoration of service. Busy passenger stations, such as that at Providence, R. I., and at New London, Conn., having been inundated, were without lights for a time. The railroad organizations thus lacked nothing of variety in re-establishing service.

Prior to the afternoon of September 21, there had been extremely heavy rainfall for several days, which had caused grave concern to railroad operating departments, and track patrols had been carefully conducted to insure against accidents to trains from washouts or landslides. There had indeed been considerable damage, some of it of a serious nature, before the hurricane appeared at all, and many trains were already being detoured. When the hurricane came it effectively interrupted wire communication over hundreds of miles of railroad route, and in view of the known hazards presented by the heavy rains, train service was arbitrarily cancelled, pending a check on the condition of the various routes.

In a number of instances, passenger trains in transit were blocked at outlying points, and it was necessary to take care of the passengers as far as possible until arrangements could be made to permit them to continue their journeys. The general blocking of highways and the absolute lack of communication facilities, both of the railroads and commercial communication companies, made this extremely difficult. It was not known, in some cases for many hours, just where trains might have been held up.

Interesting problems were presented at such intermediate terminals as New Haven, Conn., where large numbers of passengers collected in the absence of transportation facilities to permit them to continue their journeys, and were obliged to spend the night. After all available hotel accommodations had been assigned, the railroad placed Pullman cars and coaches for the use of the marooned passengers.

Restoration of passenger and freight traffic, each in its own way, was of vital concern. The large cities normally receive the major part of their food supply by rail each day, and if the flow is interrupted even for a brief period, distress results. For instance, with all routes into Boston from the west blocked, it was necessary to use such detour routes as were available, regardless of expense, and for a short time much of such perishable freight was detoured through Canada to Portland, Me., and thence to Boston.

The loss of the communication circuits, as well as of signals, was generally due to wrecking of the aerial circuits, partly on account of trees or other objects fouling the line, and partly on account of destruction from washouts. The most immediate problem in re-establishing service was the restoration of at least a bit of communication throughout the affected areas. This involved usually the laying along the ground of twisted pairs, and in some instances cable, through the damaged territory so that the most important emergency messages could be transmitted. Then as opportunity permitted, poles were set and permanent wires or cables installed.

Railroad Damage of Three Classes

The damage to the tracks themselves in general was in one of three classes: (1) washout of grade, (2) destruction of bridges, (3) landslides to the tracks from above; in addition, there was the frequent blocking of the tracks by miscellaneous foreign debris.

The railroads most seriously affected were the Boston and Maine, the Boston and Albany, the Central Vermont, and the New York, New Haven and Hartford. The Rutland and the Long Island and several other New York State railroads also were affected, but to a lesser degree.

The Boston and Maine Railroad was damaged especially between Gardner, Mass., and the Hoosac Tunnel, along the Millers River and the Deerfield River (both of which were considerably higher than they were in the flood of 1936) between Lowell, Mass., White River Junction, and Wells River, Vt., between Concord, N. H., and Wells River, and between Bellows Falls and South Ashburnham, Mass. There were 27 bridges seriously damaged or completely destroyed, 266 washouts, 22 landslides and 45 submerged locations of some length.

The Boston and Albany Railroad experienced similar types of damage on its main line between East Brookfield, Mass., and Albany, N. Y.—60 per cent of its mileage. Broken dams helped to swell the damage. Hundreds of washouts were reported. Six main-line bridges were destroyed (at East Brookfield and Huntington, Mass., and in the vicinity of Chatham, N. Y.) and five bridges on branch lines. At South Spencer and North Brookfield and several other points, freight houses were completely destroyed.

The Central Vermont Railroad suffered chiefly from floods between Norwich and New London, Conn. The terminal at New London was practically destroyed, and the railroad's large freight steamer "Vermont" was washed up against the yard tracks at New London and

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Essential substance of an address presented at a general session of the AIEE winter convention, New York, N. Y., January 23–27, 1939.

Sidney Withington is electrical engineer of the New York, New Haven and Hartford Railroad Company, New Haven, Conn.

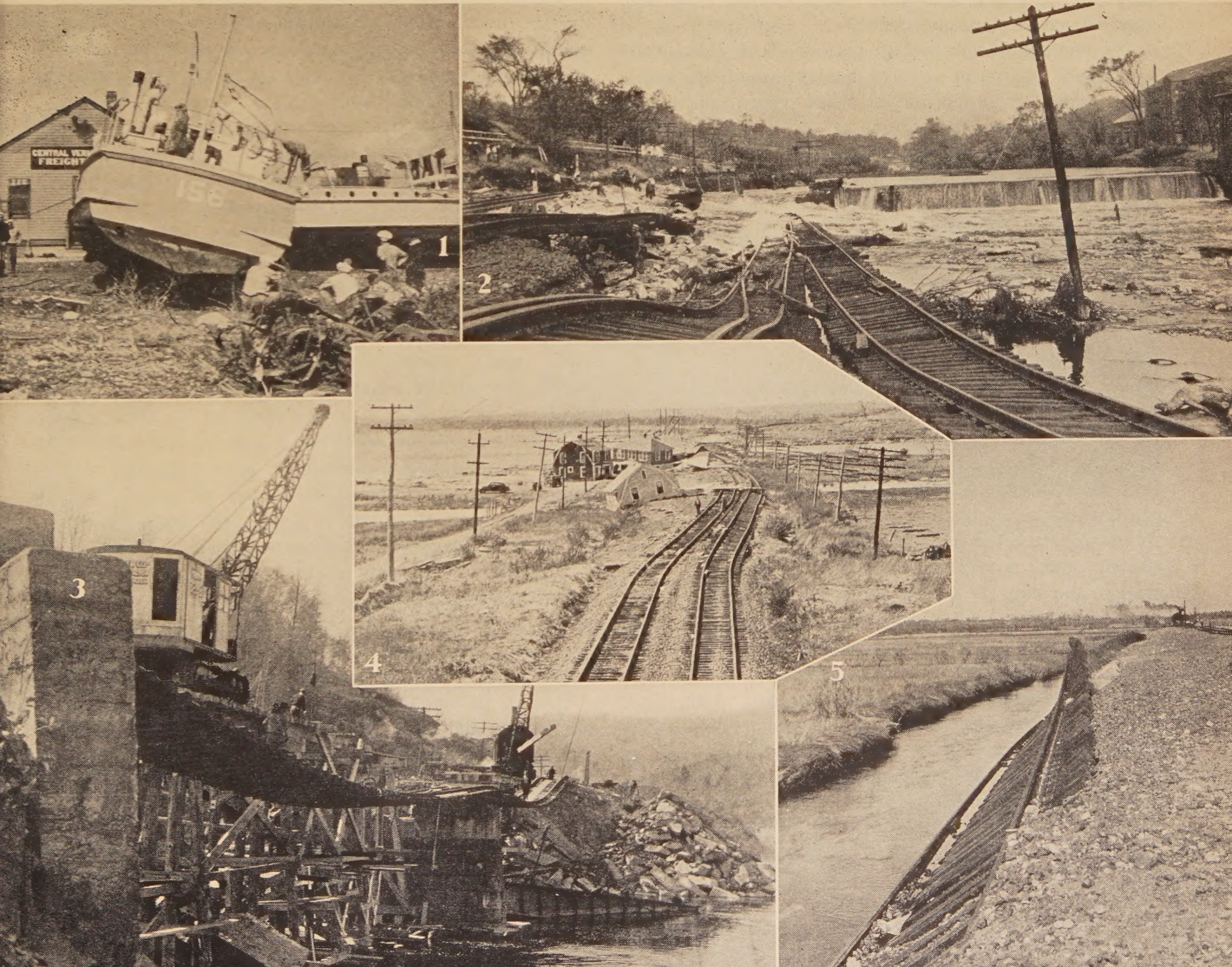
damaged. Two coast guard cutters were floated up to the door of the freight office building at New London and left there, and 25 other craft of all sizes were removed from the tracks between New London and Norwich. Considerable reconstruction was necessary at Palmer, Mass., Stafford, Lebanon, and Yantic, as well as at Norwich, Conn. The up-country damage on this road was far less than that caused by the floods of 1927 and 1936, though the 1938 situation was potentially as serious, if not more so. The credit for this has been assigned to the flood-control dams recently built in the White River tributaries at East Barre, Wrightsville, and Little River, Vt.

Several other railroads were affected in lesser degree than were the foregoing. The Rutland suffered 18 major washouts but, fortunately, no bridges were involved. The Long Island Railroad's damage along the south coast of Long Island consisted mainly of numerous washouts between the Hamptons and Montauk. High water covered the third rail in places, causing loss of power on the Far Rockaway branch and the Port Washington branch between Bayside and Port Washington. The high-voltage transmission of the Long Island was somewhat interfered with on account of high wind. The New York Central suffered washouts on its Putnam division between New York City and Chatham. The West Shore, Lackawanna, Central of New Jersey, and Erie railroads had slight delays from high water, fallen trees, and other causes, but were relatively free from trouble.

New Haven Road Suffered Most

The New Haven suffered damage perhaps more serious and widespread than any of the other railroads within reach of the storms. The type of damage consisted largely, like that of the other roads affected, of washouts, bridge destruction, landslides and miscellaneous debris on the tracks. River and the tide waves did the same kind of damage to tracks and bridges, and also inundated miscellaneous electrical facilities, such as signals, drawbridge motors, shop motors, and station facilities. The areas affected were very generally distributed, the most serious damage being perhaps on the shore of Long Island Sound, especially between Saybrook, Conn., and Westerly, R. I., and the shores of Narragansett Bay and Buzzards Bay.

Views showing typical damage to railroads: (1) These boats were left high and dry outside the Central of Vermont freight terminal at New London, Conn. (2) Failure of a dam at West Warren, Mass., caused this washout on the Boston and Albany. (3) Bridge washout at Erving, Mass., on the Boston and Maine. (4 and 5) Examples of the extensive damage on the shore line of the New Haven, caused by the tidal wave that accompanied the storm



The New Haven is electrified between New York and New Haven over the Hell Gate Bridge, with overhead-trolley power distribution. While the storm west of New Haven was undoubtedly less severe than at other points, nevertheless it was very severe even in that territory; it is of interest to note that there was no damage to the traction-power transmission and distribution facilities. There were numerous grounds, or short circuits, on the system, caused by trees and other foreign matter blowing into the wires, but as soon as the debris could be removed, the individual circuits were re-energized and there was no train delay whatever due to traction-power failure.

The traction power is partially purchased and partially produced by the railroad. The railroad power plant at Cos Cob was subject to interruption on the evening of September 21 when the tidal wave hit that vicinity and flooded the condenser pit to a depth of five or six feet, covering the condenser pump motors and other equipment. Fortunately dual drive for the pumps was available and before the water was out of the basement, cleaning was under way, and the power plant was again fully functioning at four o'clock the next morning—in ample time to handle the morning commuter travel. During the outage at Cos Cob, traction power was supplied adequately from the Consolidated Edison (N. Y.) and the Connecticut Light and Power systems, and there was thus no interruption whatever in the traction power supply. When the Edison supply was curtailed, Cos Cob and the Connecticut Light and Power system were able to carry all the load required without inconvenience.

The communication system between New Haven and New York is in lead-covered cable throughout, either underground or supported on short poles, well guyed. There was thus no interruption of any kind to the communication service in that territory.

The New Haven experienced washouts at over 250 separate points, and slides at 21 points; 43 bridges were either destroyed or seriously damaged. The length of track actually washed out was about 17 miles, the maximum depth of washed-out track running to as much as 50 feet. The number of places where the tracks were blocked by houses, boats, trees, and other debris ran into thousands.

The tracks between New Haven and Springfield, Mass., were not seriously damaged, and operation started to Hartford from New Haven as soon as the cut east of New Haven station had been freed of water. The Connecticut River, however, continued to rise until the evening of September 23, and Springfield service north of Hartford continued to be interrupted by high water for several days. At this time also the small switch house at Hartford where electric power is received and distributed for the yard, station, and shop facilities in the vicinity of Hartford, was inundated and put out of service. There was fortunately an alternative supply for the Hartford passenger station, and therefore lights were not lost there.

Immediately after the storm, the evening of the 21st, work trains were started from as many points as possible, and within a day or two more than 5,000 men were at work. The men lived in camps and in camp cars and were, in general, fed on the job.

The main line of the Boston and Maine from Troy, N. Y., to Greenfield, Mass., was opened October 1, whence detour routes through Bellows Falls or White River Junction, Vt., were used for a time, to Boston.

The Boston and Albany main line through to Boston was opened for westbound traffic September 30, and eastbound October 1.

The New Haven on September 28 opened the old air line route from New Haven to Boston, through Middletown and Willimantic, for eastbound freight, and through Willimantic and Hartford for westbound freight. The shore line was available on September 24 for passenger service between New Haven and Saybrook, and between Boston and Westerly, the intervening territory being served by connecting busses on the highways. The extent of the bus transport gap was gradually reduced as reconstruction permitted, and through shore line service was established October 5. On September 30, through passenger service between New York and Boston, via Springfield, had been re-established.

Miscellaneous Electrical Problems

Miscellaneous railroad problems in the electrical field consisted in restoration of lights and power supply to stations and shops, drying out flooded motors and rewiring control circuits, re-establishing signal and interlocking facilities, and also, as has been indicated, restoration of communication facilities (which are taken for granted in normal times, but which are the *sine qua non* of railroad operation) as well as of emergency reconstruction such as existed, where tools, material, and supplies were wanted in the shortest possible time.

Salt-water exposure, of course, presented more serious problems with electrical facilities than fresh water, and it was found that submersion was not necessary to give trouble, but that salt water spray sometimes was fully as disastrous. It was necessary to insure that motors and other electric facilities were not energized until they were fully cleaned and dried out; failure to observe this rule in some instances caused considerable inconvenience.

The damage to wood-pole communication and power lines, though chiefly from contact with trees or other debris, showed the advantages of underground cable construction, especially when connections to such cables were either installed sufficiently high to avoid floods or when the pothead installations were properly waterproofed. Underground construction, of course, would have been of no advantage in washed-out territory, where the most serious railroad damage occurred.

Small portable gasoline-engine generating sets were very handy in supplying temporary emergency lights and small power requirements for local freight and passenger stations, and for floodlighting construction work at night, when power was not otherwise available.

It may be said that in general, except for the communication and signal power-supply circuits, the principal damage to railroad facilities was essentially *not* hurricane damage, but damage by water, fresh or salt, from the rivers and from the sea.

III—Hurricane Experiences of Power Utilities in Long Island

By E. W. DOEBLER

THE Long Island Lighting Company system extends from the Rockaway beaches to Orient and Montauk points on the eastern end of the island, although the main part of our territory is, of course, outside of the city of New York. This territory is a little more than 100 miles long and at right angles to the path of the storm, with a maximum width of about 25 miles and a population in the whole area of something less than 700,000 people. The system has three main generating stations, one at Far Rockaway on Jamaica Bay, one at Northport on the north shore of Long Island in Suffolk County, and our principal station at Glenwood Landing which is also on the north shore in Hempstead Harbor. These stations feed into two 66-kv circuits on steel towers running down the backbone of Long Island. The hurricane of September covered this whole area and disrupted the service in varying degrees and intensities in practically all of it. Although the wind velocities reached as high as 100 miles per hour, the damage to transmission and distribution lines was caused almost entirely by trees falling against the poles or across the lines, except in some cases where the poles were set in soil which became really drifting sand due to the high water.

We lost our first distribution substation at 1:15 p.m. on the day of the storm and at 5:00 p.m. practically all distribution substations except those connected with generating stations or directly connected with the 66-kv substations were without service. There were no particular engineering problems connected with the reconstruction of the transmission and distribution lines. The main job was applying man hours to the most vital points. To get an over-all picture of the problem, we made airplane surveys the morning after the storm. The more important substations were re-energized by 10:30 p.m. on the night of the storm, and all the substations except six small isolated stations on the beaches were back on the lines by 7:30 p.m. the following evening. As the substations were re-energized, the efforts in each district were directed to connecting waterworks, sewage systems, hospitals, telephone exchanges, and the company's three gas plants.

After these vital public services were reconnected, our man hours were directed to giving service to the greatest number of people with the least amount of work. No attempt was made to give individual service until this main heavy job had been completed.

Greatest Difficulties Caused by High Water

Our real engineering problems arrived after the storm had passed by. They were caused by water. The Far Rockaway plant experienced the high tide at 6:20 p.m., and the water was $2^1/_4$ feet higher than normal high tide. It was within a few inches of the condenser auxiliary floor. Comparing this height of water with what we might expect in the other two stations, we thought the worst was over. At 7:38 p.m. our Northport plant was shut down by a tide that had reached about $7^1/_2$ feet higher than normal high tide, submerging 28 motors in addition to voltage regulators, electrical auxiliaries, cable controls, and other equipment.

Finally, at 8:23 p.m., our main generating station at Glenwood was flooded. The tide rose to about 10 feet above normal high tide and submerged 72 motors, totaling 6,400 horsepower, in addition to cables, controls, rheostats, transformers, and other miscellaneous equipment; added to this was the loss of telephone service for 15 hours.

After the new Glenwood plant (at Glenwood there are two plants, an old one and a new one) was dewatered, the equipment that had been submerged was flushed with hot fresh water to wash out the sea water, thus reducing the amount of salt that might be deposited and preventing an excess of corrosion.

The rehabilitation of the equipment, and of the electrical equipment particularly, can be divided into three divisions: (1) motors, (2) control equipment, and (3) rheostats and grid resistors. The motors in the new Glenwood plant are wound generally for 2,300 volts. These were dismantled, again flushed with hot fresh water and then with carbon tetrachloride. The motors were then baked, the larger ones in homemade ovens in the plant, and all the

This typical view shows the general wreckage of summer homes at Fire Island Beach, Long Island, N. Y.

Essential substance of an address presented at a general session of the AIEE winter convention, New York, N. Y., January 23–27, 1939.

E. W. Doebler is general operating manager, Long Island Lighting Company, Mineola, L. I., N. Y.

rest in the service stations of General Electric and Westinghouse companies. After sufficient resistance to ground had been obtained, the coils were sprayed with insulating varnish. When reassembly had been thoroughly checked, the motors were given a two-hour test run and then considered ready for service.

The reconditioning of the control equipment was particularly troublesome, especially the equipment for controlling the 600-horsepower motors for the boiler feed pumps. It was finally found to be better to renew the small parts than to recondition them.

The rheostats for the generator and shaft exciter were dried by heating to almost red heat by means of torches. However, it took so long to dry out the neutral resistors that the station was returned to service with an ungrounded neutral. In this way, a 20,000-kw unit at the new Glenwood plant was back on the lines ten minutes less than three days after the shutdown and the 75,000 unit was back in six days and two hours after the shutdown.

In the Northport and the old Glenwood plants, the auxiliaries are run by 220- and 440-volt motors, so we thought we could take chances with these smaller motors that had been submerged. As a result of taking these chances, one of these units was on the line just after midnight the night of the storm. All the units of these stations were on the lines the evening of the day following the storm. It is true that a few small motors were burned out, but they were motors that could be replaced easily.

In addition to these items, we have a few other observations. Of course, it goes without saying that we are going to do what we can to prevent a similar occurrence in so far as the location and the design of the plants will permit.

Pole Damage Caused Mostly by Trees

Practically all of the 1,100 poles that were taken down during the storm were down because of falling trees. Our experience is that where there were no trees or where the clearance was good, we had no trouble, or very little.

We believe that everyone should have an emergency program for distribution lines, showing for each substation district the proper sequence of the restoration of service so that the most important locations will get service first. In case of a catastrophe like the shutdown at Glenwood, we believe authority should be delegated to one person so that decisions may be reached quickly. We also think that the work should be subdivided into small jobs and one man made responsible for one particular job. Frequent reports should be gathered and tabulated and bulletins issued at frequent intervals so everybody concerned can know the exact progress of the work. We observed that all the employees, no matter what their jobs, will work and continue to work beyond the limit of human endurance in order to make the best possible records for restoration of service; but to get the best results, we believe that the work period should be limited to at least a maximum of 12 hours after going through the first night.

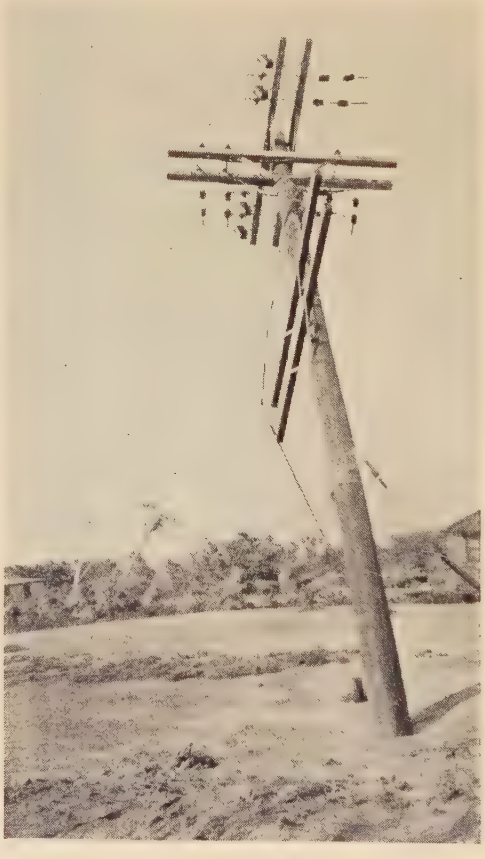
We are a little dubious about complicated electrical controls such as for the boiler feed pumps when they are subject to being flooded by sea water. If it is not practical to install the complicated electrical controls at a height beyond any possible flooding, it might be advisable to find a simpler method of control.

Public Relations During Restoration

One other problem which we believe is probably more important than the engineering problems is handling the public. Motors can be replaced, but it is not easy to replace a good feeling from the public. In our experience, we organized forces in the field to get information into the district offices where people were answering telephones and otherwise taking care of customers, keeping them up to the minute in the progress of reconstruction so that the best possible and the most intelligent information could be given to the customers in order that they might know what to expect. Most of them were interested not in whether they were going to have service the next minute but when they might expect it.

As a result of that program, we believe that we were accorded much greater tolerance from our customers and that there was a better feeling, even among the customers themselves.

One good thing that came out of the storm as far as we were concerned was this: There is often an unwholesome feeling between employees of commercial departments and operating departments, and in some places they seem like two different companies. We have had similar experiences, but after the storm was over, everybody recognized that everybody else's job probably was just as important as his. We have found a much better community of interest among all the departments as a result of this storm.



This Long Island pole line withstood the high wind, but the poles were displaced where the soil was weakened by highwater

IV — Hurricane Experiences of Power Utilities in Connecticut

By C. W. BROWN
MEMBER AIEE

EXCLUSIVE of the Cos Cob station (referred to in article II of this series) there are five steam generating stations along the Connecticut coast owned by three different operating companies. These stations are at Montville, New Haven, Bridgeport, Devon, and Stamford. As a result of the storm wave, the Montville and Stamford stations suffered outages because of flooded essential auxiliary equipment. New Haven and Bridgeport stations did not shut down, but did have a few nonessential motors flooded. At Devon, earth barricades excluded water from the station.

Following four days of torrential rains the Connecticut River rose 30 feet at the Hartford steam station. This was within 2 feet of the 1936 flood crest. The Hartford station, however, is bulkheaded to withstand a rise of 35 feet.

Throughout the state, modern hydroelectric stations with adequate dams and spillways were not materially damaged. Equipment was wet in some of them, and all had to reduce load because of high water. Several small, antiquated stations were destroyed, and these will not be replaced.

Wind damage was much more severe in the easterly part of the state than in the westerly part. A few towers in the Hartford-to-Massachusetts line failed at the ground line when the anchors on the tension side pulled through the saturated earth sufficiently to buckle the members on the compression side. These towers were easily righted temporarily by guying. There were no tower failures from wind in the westerly part of the state, but one tower did have footings washed out. At New London, on the east, about 6 per cent of the distribution poles went down, whereas in Stamford, in the west, only one-fifth of one per cent of the poles had to be replaced.

I shall refer now particularly to New London, but in general my remarks can be applied broadly to The Connecticut Power Company as a whole, and to a slight degree to The Hartford Electric Light Company.

Timing of Rehabilitation Work Important

Our problem was very much one of timing. For instance, during the first few days when the streets were completely blocked by fallen trees, we could not have used a great number of line trucks and crews if we had had them. At this stage, squads from the planning department and tree men were more important than linemen. As the streets were cleared, crews were built up by classes to salvage or remove equipment; to deliver poles and to set poles; to do normal line work; and to run services. As the work progressed line crews were released and service-running crews augmented. For these we worked in a great many house-wiring electricians. Most of our outside help came from Pennsylvania, Ohio, and Michigan. These men fitted themselves into our organization as if they had been with us always.

The things we did and would do again are as follows:

1. We had an emergency organization setup and adhered strictly to it—for publicity, public relations, planning, supervising, purchasing, accounting, and for carrying out the work. Some departments were transferred, or augmented, or specialized, while other departments had to be created to cover items peculiar to the emergency, such as arranging for rooms, meeting incoming crews and other matters.

2. We set the working schedule to hours that could be carried out day after day without undue fatigue, and permitted no deviation from the schedule. During the 1936 flood, we were not so careful about hours as we were following the 1938 hurricane.

3. We agreed promptly with the telephone company on the streets in which each of us was to set poles, regardless of which company was custodian.

4. We worked from detailed and up-to-date maps. By doing so we were able to reduce to a minimum the paper work required of foremen, without plant accounts suffering in any way.

5. We pulled butts and set new poles in old locations. These old locations, in most instances, came into being only after the issuance of applications, permits, and consents, and in accordance with statute, ordinance, and regulations.

6. We worked all primary lines dead. Our normal forces were increased tenfold, and the risk from live work was too great to take.

7. In spite of some criticism, we made services alive only when someone could give access to the building. We had no fires from this cause, but other territory did.

The methods we would change are:

1. We would avoid congregating large groups of men in a single restaurant. Even though meals were staggered to some extent, the danger was very real.

2. While in general we were able to keep ourselves supplied with line materials, the difficulty in securing some few items showed the advisability of making a shift in our purchasing policy so as to give business in normal times to nearby manufacturers.

3. We would be more prompt in our contacts with public authorities concerning some items. For instance, a great many helpful services to the community were performed by WPA, CCC boys, and others by assisting in clearing the streets. Their axes sometimes were used to the detriment of conductors, but we might have prevented this by anticipating it.

4. We would probably give more publicity to the importance of customers having their damaged services repaired. Some undue delays resulted from customers' neglect, in spite of newspaper bulletins.

Some forms of lack of co-ordination are difficult to anticipate. For example, in one or two instances public institutions through political appeal arranged with public authorities for temporary use of internal-combustion-

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Essential substance of an address presented at a general session of the AIEE winter convention, New York, N. Y., January 23–27, 1939.

C. W. Brown is director of engineering of The Connecticut Power Company, New London engine generating sets, only to find after long hauls over difficult detours that our service already had been restored, or to find that the generators were not applicable.

The following general comments may be pertinent:

1. The remark was made several times after the storm to the effect that falling trees showed the disadvantage of lighting companies occupying joint poles with the telephone company when the telephone company used messenger and aerial cable. This comment was prompted by the fact that the pole is weaker than the messenger, and the falling tree often resulted in a broken pole. The thought, of course, was that with only the open wires of the lighting company, the conductor would break and these repairs could be made fairly promptly. There are two sides to this argument. The first circuit which was energized in New London and which became the first main feed for restoration of service, was a 350,000-circular-mil aerial cable. It lay in the gutter and was tangled in the branches of fallen trees, but was uninjured. In general, the storm did not change our ideas as to the advantages of aerial cable in particular locations, although some aerial cable was destroyed.

2. Pole lines would have given little trouble had it not been for trees and washouts.

3. Troubles with underground construction were in locations where transformers installed in building vaults were not of the subway type. Potheads, cables, and other apparatus in these vaults, as well as transformers, were damaged by flood water.

4. Uprooted trees in residential areas destroyed underground electric and gas services. There were not a great number of these, but they show that underground construction is not entirely immune to hurricanes.

5. Property damage of The Hartford Electric Light Company and The Connecticut Power Company amounted to approximately $650,000. This sum, even if hurricanes and other disasters occurred more frequently, falls far short of justifying, economically, underground construction in overhead areas. But another economic question is not so easily answered, namely, how much raising or protecting station, substation, and other equipment is justified? Within two years two floods in the Connecticut River Valley have exceeded crest records extending over a period of nearly a century. This problem is now being studied.

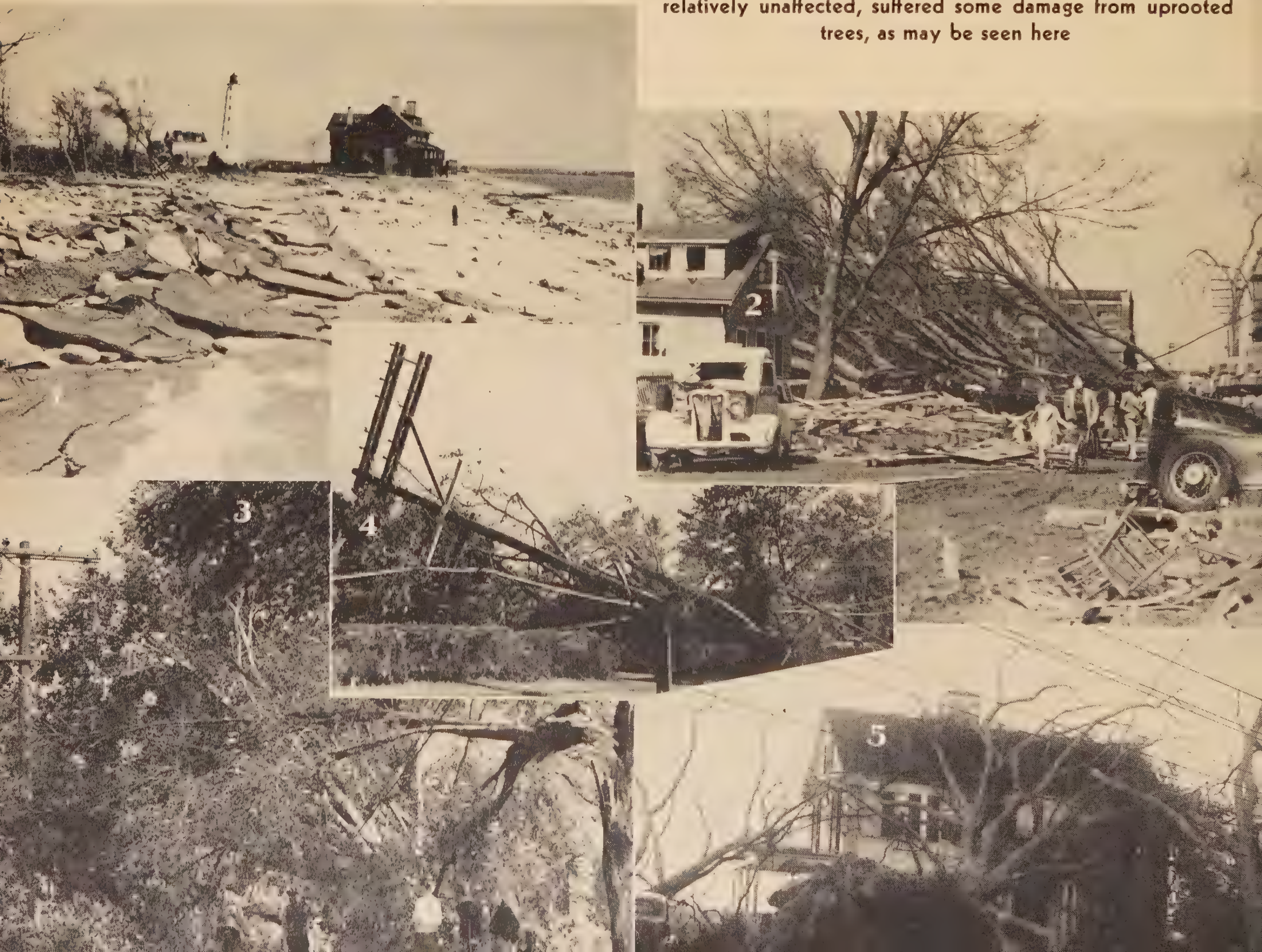
Figure 1. Along the shore at New London, Conn., the sea wall and highway paving were destroyed, and pole lines and water mains were completely washed out

Figure 2. Power lines were completely demolished in the general wreckage here, but may be seen intact in the background

Figure 3. This pole in Woburn, Mass., escaped the falling trees

Figure 4. Damage to this line in Milton, Mass., is typical of the tremendous damage to pole lines caused by falling trees

Figure 5. Underground gas and electric mains, although relatively unaffected, suffered some damage from uprooted trees, as may be seen here



V—Hurricane Experiences of Power Utilities in Boston Area

By T. H. HAINES
MEMBER AIEE

THE PATH of the hurricane disturbance over New England embraced the entire system of the Boston Edison Company. The wind velocity of the hurricane at the Blue Hill Observatory near Boston situated 500 feet above sea level approximated 186 miles per hour at 6:47 p.m. on the day of the storm and several sustained gusts of 111 miles per hour were recorded over five-minute periods. In general, the maximum wind velocity at the ground throughout our area was estimated to have been in the vicinity of 85 to 100 miles per hour. There was almost no rain in Boston although rain elsewhere resulted in extensive floods.

The Boston Edison Company supplies electricity to Boston and 39 other cities and towns in a contiguous territory west of Boston, embracing 600 square miles and having a population of 1,400,000 people. This area forms roughly a 30-mile circle with the City of Boston at the eastern edge.

Reaching the southern portion of our territory at about 5:00 o'clock, the storm progressed rapidly over the entire area and by 7:00 o'clock 166 of our 225 primary distribution circuits and a corresponding proportion of series lighting circuits were dead. Substantially all of our overhead transmission, except lines on cleared rights-of-way, were out due to line troubles. Only the d-c network and a portion of the a-c underground system in the City of Boston remained unaffected. Damage to power plants was quite nominal except for two coal bridges, one of which was wrecked beyond possibility of feasible repair and the other not so seriously but that it could be put back in service within a few days.

The following morning all of our own 110-kv transmission lines were found to be intact, although the southern line had been interrupted during the storm by the failure of six towers in the territory of the New England Power Company, due to softening of the earth footings.

The southern line is of double-circuit vertical steel construction in our territory, while in the New England Power end of the line, and in our northern line, the circuits are carried on separate semi-flexible H-type steel towers, the conductors being in a horizontal plane.

In one of our 66-kv wood-pole lines four poles were blown out of line by the wind near a swamp where the footings were softened by high water, but were not broken. At another location one pole was found broken at the ground and leaning. On another 66-kv line one wire was broken by trees. All 15-kv transmission lines, which are not on cleared rights-of-way, were out because of tree interference.

Our distribution system was found to be in a generally wrecked condition. Damage was due almost entirely to tree interference and, in general, distribution lines were unaffected by the wind pressure alone. These illustrations demonstrate the fact that the force of the wind, even though of extremely high velocity and sufficient to blow down many big trees, did very little damage to the lines where there were no trees or where the trees fell *away* from the wires. Trees falling *on* poles and wires, however, resulted in a vast amount of confusion and damage.

One unusual exception to the general type of damage occurred in a pole line consisting of 55-foot poles, some with nine double eight-pin crossarms. This line carries 44 primary and series lighting wires feeding four towns. All these lines were opened at the station soon after the first one tripped out during the storm. About five minutes later five adjacent poles in this line snapped. Two of these broke about 20 feet above ground at the telephone through-bolt, the others at lower points, allowing the heavy tops to fall into the street.

Five line crews and a supervisor worked under the existing incredible conditions of wind and darkness, lifted the fallen pole tops in unison, set them back upon the broken stubs, lashed the tops and stubs together with 30-foot poles, and guyed the tops—all without breaking or cutting the conductors. This feat was accomplished by 7:00 o'clock the following morning.

Although the serious hazard to the system of such congestion had been previously recognized, this experience clearly emphasized the need, and our budget now provides for placing such leads underground.

Reconstruction

On the day following the storm, the work of reconstruction of primary and secondary circuits began on a dawn-to-dark basis. Our normal line force of 253 men was expanded as speedily as possible to approximately 2,000 by additional line crews and labor of all descriptions recruited from various local sources, as well as from utilities outside the New England area. An emergency organization was quickly established with field units suitably located for the purpose of co-ordinating the restoration activities of the entire area.

Thirteen days after the storm, upon practical completion of primary and secondary restoration work, customers still without service were invited by an announcement in all newspapers to notify the company. Calls received indicated that only 660 were still without service, and two days later these were reduced to less than usually occurs on a normal day due to blown fuses and minor trouble. The restoration of the series lighting load occupied another two weeks.

In spite of the fact that it was necessary to use a great

Essential substance of an address presented at a general session of the AIEE winter convention, New York, N. Y., January 23–27, 1939.

T. H. HAINES is superintendent of transmission and distribution of the Boston Edison Company, Boston, Mass.

many inexperienced employees on this work, accidents were comparatively few.

Although the experiences described are those of the Boston Edison system, the overhead systems of utilities in other Massachusetts and Northern New England communities in the path of the hurricane were similarly affected. Additional damage occurred along the southern coast of New England, where tidal waves flooded large areas. In the City of Providence, R. I., for instance, electrical equipment was completely submerged in salt water, necessitating thorough washing and drying out before service could be restored.

Analysis of Line Construction Experience

Although the effect of the 1938 hurricane on our overhead lines was the most severe since the great sleet storm of 1921, careful analysis of the disaster convinces us that there was no outstanding weakness in our line construction, and had it not been for falling trees the terrific wind velocities would have caused only negligible damage to normal distribution construction.

Observations made from the storm experience may be classified in two types—administrative and technical. Of the former, the following are most prominent:

1. It is advisable to have in readiness a general emergency organization plan to facilitate quick action with a minimum of lost motion. Doubtless many errors of judgment could have been avoided and time saved if a plan had previously been in existence.

Five poles in this line at Woburn, Mass., snapped off, but conductors remained intact. Line crews, working under the extreme difficulties imposed by wind and darkness, lifted the pole tops in unison, set them back upon the broken stubs, and lashed them to 30-foot poles—all without breaking or cutting the conductors

2. Judicious use of paid advertising to tell the public the truth of our situation paid dividends in complete public understanding of our problem and improved public relations.

3. If a line organization is to be expanded from five to ten times in a few days, quarters and facilities, both in the office and for stock handling, must be available to provide for the increased personnel or a decentralization plan should be placed in operation quickly. Our greatest difficulties and congestion were experienced where the operating quarters were just adequate for normal conditions.

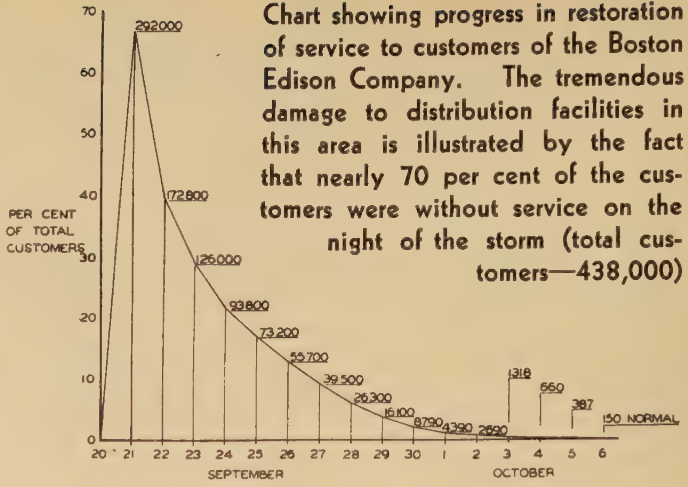


Chart showing progress in restoration of service to customers of the Boston Edison Company. The tremendous damage to distribution facilities in this area is illustrated by the fact that nearly 70 per cent of the customers were without service on the night of the storm (total customers—438,000)

4. An organization separate from the line department placed in the field to maintain contact with local officials and the public, and divert such contacts from the ordinary operating and construction forces is essential.

5. The existence of local line-construction contracting forces which can be expanded quickly under stress and which are familiar with locations and local methods was amply justified.

6. Supervision for imported line crews and others was an urgent need, and how to provide this at such a time has not been solved.

7. Two-way radio communication doubtless would have been a valuable aid in reducing the time to restore service. In at least one instance carrier current over transmission lines proved valuable as a means of communication in the absence of telephone service.

8. Temporary reconstruction regardless of appearance, but with due regard for safety, may be the more expensive method, but it is essential for quick restoration.

From a technical standpoint the following is presented:

1. More extensive standardization of engineering design, construction methods, and materials used in our industry would assist greatly when crews are brought from a distance, not only because they could work more expeditiously, but also because they could bring their own supervision which could act then with little or no local help. Furthermore, material in national use is most easily obtained.

2. Our own overhead construction practices—selection of poles, depth of pole settings, wide primary conductor spacing—with a few minor exceptions satisfactorily withstood the impressed wind loads. No reasonable construction could have withstood the falling trees.

3. The concentration of too great an amount of construction and equipment upon certain individual poles which can be destroyed easily by a single tree or by other accidents should be avoided where practicable.

4. Multiple street lighting registered an advantage as it was restored simultaneously with customer services while the series circuits remained dead until all other service was reconnected.

5. Automatic line splices and solderless tap connectors were an invaluable help in speeding the reconstruction work, not only with the line crews, but also with the inexperienced wiring contractors who were pressed into service.

We present these observations and analyses to the industry in the hope that our experience may in some way assist others in lessening the effect of any similar catastrophe which it may be their misfortune to encounter.

VI—Hurricane Experiences of the Telephone Companies

By W. H. HARRISON
FELLOW AIEE

EXPERIENCES of the telephone companies are naturally much the same as those already described. The aftermath tally showed that more than one-half million telephones were put out of service—in the New England States about 30 per cent of the telephones in that area. Through the destruction of toll lines, the storm temporarily cut off telephone communication with the outside from over 200 towns. The total damage to telephone plant was in the neighborhood of ten million dollars.

The story of restoration—the immediate provision of emergency services—the handling of emergency supplies in unprecedented quantities—the augmenting of forces locally to supplement the normal forces—and the mobilization of forces from other areas—all are replete with engineering interest and are very intriguing; but it would not be appropriate to attempt to tell the whole story here. A few facts will give a sketchy idea of the situation.

Some of the materials required to repair the damage were:

3,500,000 feet of lead-covered cable.
54,000,000 feet of paired wire.
7,000,000 feet of stranded steel cable for guys and supporting cables.

Local construction forces were expanded from 3,000 to 5,000. In addition, 2,400 highly skilled linemen, cable splicers, and installers, and over 600 fully equipped construction trucks and other special motor vehicles were brought from 14 other telephone companies as far south as Virginia and as far west as Nebraska and Arkansas.

Of striking significance in the prompt restoration of service was the traditional Bell System background of standardization of materials and methods. This standardization greatly facilitated the collection of large quantities of suitable supplies and made possible maximum effectiveness of the men who came from many parts of the country. The striking effectiveness of these measures is a great tribute to the engineers who long ago, by their recognition of the value of standardization, laid the broad foundation for this effective work.

In every disaster much is learned with regard to formulating plans and caring for specific situations. Of interest in this specific situation, there had been serious floods in much of this territory in 1936. The experience at that time pointed to certain precautionary measures and we know of no case where these did not prove effective in the present situation. For example, while the water rose 5 feet above the ground-floor level of the main telephone building in Hartford, Conn., it was successfully kept out of the building by bulkheads about the doors and windows, provided since the 1936 flood. Also, at various places where lines had been carried away due to the failure of bridges or other forms of river crossings the restored lines did not fail.

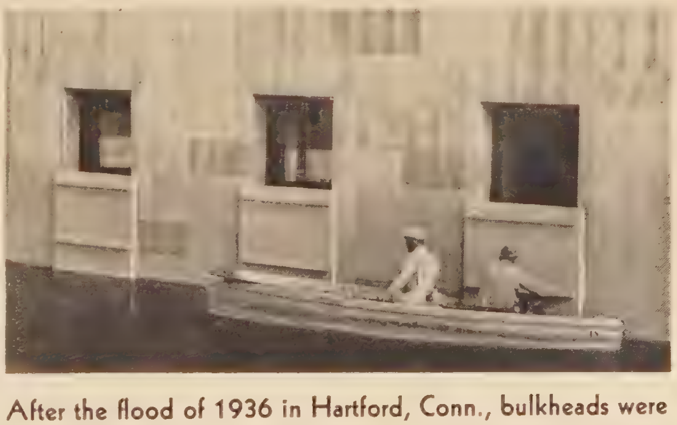
Over and above all these more or less specific points, which I might say are somewhat routine, lies a broad engineering fundamental vividly illustrated by this whole experience.

Engineers by their work have made a pattern of life that has come to make individuals and communities dependent to a large extent in their day-to-day activities and mode of living on the proper functioning of the services of power, transportation, and communication. Having done this, they have seen their works fall before the fury of nature—have seen the utter disruption of the organized scheme of life, with all the anguish that goes with such disruption.

In the light of this experience an engineering fundamental of first magnitude presents itself, and one that offers a long-range problem that is going to call for nicely balanced judgment, both on the part of the engineer and the management. This fundamental stands out clearly—dependability of service, and specifically the degree to which dependability soundly and wisely can be built into the physical plant.

It is trite to say that dependability is fundamental to good service, that it is of prime consideration in the design, construction, and operation of all communication, power, and transportation facilities. On the other hand, it would be foolhardy to assume that any man-made structure could completely withstand the fury of the elements, as typified by this storm.

Consider the circumstances. For four days rain was progressively heavier. It totaled between five and ten inches at many New England points. At some places more than six inches of rain fell in one day. As a result large rivers were brought to flood stage and small brooks and streams became raging destructive torrents. And then came the hurricane—then the seas. Wind velocities



After the flood of 1936 in Hartford, Conn., bulkheads were built for the doors and windows of the telephone building nearest the river; these successfully kept the water out of the building during the flood accompanying the 1938 storm

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Essential substance of an address presented at a general session of the AIEE winter convention, New York, N. Y., January 23–27, 1939.

W. H. Harrison is vice-president and chief engineer of the American Telephone and Telegraph Company, New York, N. Y.

as high as from 120 to 180 miles per hour have been reported. Raging flood and tidal water inundated important sections of many communities. Our services extended over the entire band of the storm and we can definitely trace the relationship of high wind velocities and resultant damage.

Another important circumstance, and bearing particularly on engineering consideration, is that nothing like this had happened in this area since the year 1815. Obviously, to build plant to be unyielding to the sea and to be hurricane tight against such occurrences at century intervals would be as unsound as to ignore them altogether. Thus a challenge is presented to the engineer taxing his best judgment: on the one hand, not failing to take every reasonable precaution in the future design of the plant, such as the avoidance of known exposures, the provision of alternate routes, the use of emergency restoration facilities of every conceivable character, adequate emergency operating routines; and on the other hand, not to be led by the tragedy of the storm to recommend extreme construction and operating procedures such as wholesale substitution of underground for aerial plant, which would obviously not be in the public interest.

This, it seems to me, is the broad lesson that we draw from this experience and the challenge presented to the engineer.

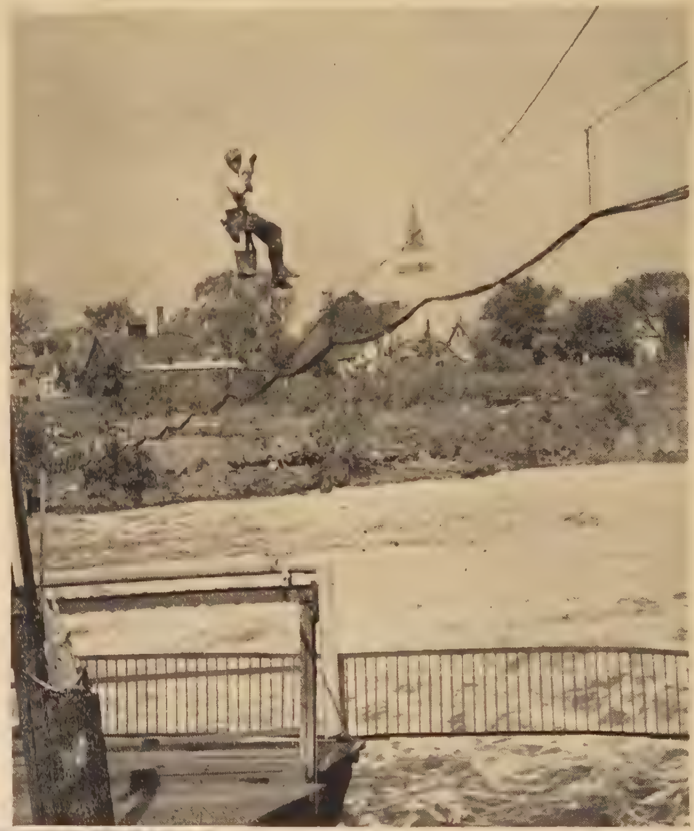
A Tribute to the Restoration Forces

It was my good fortune to have been in the midst of the restoration work. It was comforting and inspiring to see how the men and women of all service agencies responded to the call, each presented with a trying problem of his own, but ever ready to lend helpful and effective cooperation to those in other utilities, and all motivated with the common objective of maximum service to the community in this period of great distress. I know we in the telephone end could not have done our job had we not had the help of others, including the highway and other public agencies.

The final measure of any man's work is: Has it been for mankind? A grateful public has put the mark of approval on the work of the men and women of the utilities and transportation groups in the stricken area. My admiration for them knows no bounds. Frequently when we fail of expression we turn to the pens of immortals.

Two lines in one of Kipling's poems "Sons of Martha" beautifully express the work of these men and women:

> Not as a ladder from earth to heaven, not as a witness to any creed,
> But simple service simply given to his own kind in their common need.



After the bridge at Chicopee Falls, Mass., washed out, taking with it two telephone cables, the Coast Guard fired the first line across the 700-foot flood with a Lyle gun. What followed is shown above—temporary twisted pairs spanning the river, and a lineman riding another suspension cable preparing to pull across a full-sized cable

This damage to overhead telephone lines in Spencer, Mass., is typical of that caused by falling trees throughout the affected area

The Engineer's Social and Political Relations

By **JOHN C. PARKER**
PRESIDENT AIEE

Remarks made by President Parker at a general session of the recent AIEE winter convention on the subject of the social and political relations of professional bodies are presented here.

AT A GENERAL session of the AIEE, it is not inappropriate that the president of the Institute lay before the members for their personal consideration some of the circumstances surrounding the social and political relations of professional bodies.

I assume that the technical aspects of engineering work are of the very essence of the Institute's existence. As there can be no science of medicine without biochemistry, physiology, and anatomy, so there can be no profession of engineering without experimental research and theoretical analysis into the operation of the forces and materials of nature as combined in devices and structures created for the service and convenience of mankind.

Through a long period of years—as far back as I can recall—there has been an insistence on the part of a large group of engineers that our technical papers and discussions were a narrow activity; that by one device or another we must devote ourselves to the service of government, to demanding professional recognition for engineers, to improving the economic status of the engineer. There can be no quarrel with some, at least, of the insistence on a broader conception of our professional duty, however much opinions may differ as to the methods to be employed. There is, however, a perfectly sound and valid, indeed an inescapable criticism that must lie against any thought that the scientific aspect of the work of our professional societies is negligible or even of secondary importance. We cannot hope for recognition except as we merit it, and we shall not be found to merit recognition if we ourselves fail to recognize a fundamental duty that we bring about a widening and a deepening of our knowledge of applied natural law and a fuller dissemination of that knowledge.

However much we should do beyond this, this is essential.

The work of the engineer, of course, differentiates itself from that of the pure scientist, the mathematician, the physicist, the chemist, in that we are concerned primarily in the direction of the forces and materials of nature for the convenience and comfort of mankind.

While the most advanced engineering is profoundly concerned with the discoveries and developments in the field of pure science, engineering as engineering, nonetheless, is concerned primarily with the directive function. The direction of pure science toward social objectives must find a physical embodiment in machines, devices, structures, and circuits. To this embodiment we give the name of applied science. The function of application is what sets the practicing physician or the clinical investigator apart from the researcher in pure science. Similarly in engineering, the practitioners differentiate themselves from the mathematicians and physicists through an emphasis on the operations of scientific laws in tangible embodiments designed and produced for utility.

Still we are in the field of theory. To this, in the spirit of realism, must be added the criteria of experience. It is not enough that one of our engineering societies should concern itself with the application of pure science through design to the development of structures, circuits, and devices, but we must, as well, know how these work out in practice in order to appraise how fully we have directed the materials and forces of nature to the service and convenience of mankind, in fact as well as in intent, and so a reasonable portion of the literature and of the discussions in our Institute properly must concern themselves with the so-called practical aspects of engineering, albeit these latter are no more practical in fact than the design, the research, and the analytic processes which are fundamental to all practice.

So far, the work of the engineer is entirely technical. If our technical work is not to miss its objective of serving the convenience and comfort of mankind, it must do so under terms and conditions laid down by the society which it purports to serve. If men in free society do not willingly contribute a portion of what they create to enable a realization of our nicely developed technique, to that extent we shall have failed to accomplish the very service for which engineering exists.

Our engineering processes are, by definition, economic in character. Indeed much of the finest engineering that is done is directed toward the discovery of new materials, toward the evolving of new theories or the extension of old ones, toward a greater refinement in application and assembly and management of engineering devices guided and controlled by the application of economic principles.

An engineering paper does not cease to be an engineering paper because it takes into account a nice balancing of fixed and operating costs, nor will it be entirely amiss to evaluate the social contributions of an engineering development against what must be taken from society in order to produce it.

Our engineering is not done in a vacuum. It is performed in a very real society controlled by the actualities of life.

Because of these considerations it seems to me eminently proper, indeed unavoidable, that the Institute should concern itself with the impingement of economic factors on technical problems and that the members of the Institute should have made available to them every stimulus to a fuller awareness not only of the economic but of the social implications of the work of the engineer. Such a meeting as this general session is directed to precisely that point of view, not that we should render our technique superficial through an amateurish dabbling in the economic science, but that we should give perspective to our professional work through an appreciation of its values and its limitations.

Because of a happily increasing recognition of the importance of engineering process in an increasingly industrial society, because of a wholesome professional restlessness on the part of engineers, it comes about quite naturally that members of the profession are more and more anxious to take part in the social, the economic, and the political affairs surrounding them. In that this broader outlook keeps us from being mere technicians, it is a hopeful sign. We must, however, be on our guard that we do not jump from one form of narrowness into another—from the assumption that because we are engineers we need not concern ourselves with anything other than engineering to the equally fallacious assumption that because we are engineers we are able to speak with authority on any problem that has an engineering aspect.

This modern society of ours has very few aspects that are not concerned, first or last, with engineering, and to assume that as engineers we can bring within the scope of our societies every matter that involves engineering would be almost tantamount to saying that engineers are prepared to take over the governance of society.

The particular knowledge of the engineer and the engineering method of approach are of extreme value and should be available to society in the meeting of each of its problems which has an engineering content. Indeed I doubt whether there are any social problems in which the objective factual methods of the best engineers are not of value. On the other hand, the very application of the engineering method must tell us that even in primarily engineering projects there are features of critical importance quite outside the specialized expertness of the average engineer, or indeed of the engineer as an engineer. May I hazard the suggestion that on many of the most acutely controversial issues involving engineering works the real problems are neither scientific nor those of the engineering profession, but rather that they are primarily matters of social philosophy in which other groups may be vastly more expert than are the engineering societies.

Whether these other groups be organizations for social improvement, for political research, or for the practical execution of social and political philosophies, it is through them, rather than through our professional societies, that engineers of the broadest interest can give expression to their sense of social responsibility.

Wisely the Institute has insisted that, neither directly nor through its agencies, will it commit itself to activities outside the field of professional engineering. Since it is made up of large groups of valued members who may, with reference to any social philosophy, constitute a minority, while at the same time they are as able and devoted members of the profession as any numerically preponderant group, it is not deemed the part of proper professional conduct to make difficult for them the privileges and the rights of membership, nor through a dissipation of our resources to deprive of the full benefits of membership those equally devoted and important members of the profession whose interests are primarily in the field of professional discussions and personal contact for mutual stimulus in the technique of engineering.

On the other hand, those engineers who are qualified and inclined to render the profession serviceable to the economic and social objectives of society should be stimulated to do so in collaboration with nonengineers, both informally and through groups organized for such special purpose. If the socially or politically minded engineer will bring into his association with lawyers, social workers, economists, and civic organizations, or even into the pressure groups frankly organized for some specific purpose, something of his special knowledge, his logical training, his intellectual integrity, he can accomplish things which would be denied to him working only in an engineering organization. If there is anything in our profession worthy of respect, he will bring about, through this process, a social recognition of our professional merits, a greater understanding of engineering, and an influence of the engineer on the minds of men and on their legislative enactments and administrative processes.

Aerial view of the largest oil-tool manufacturing plant in the world, to which an inspection trip is scheduled during the forthcoming AIEE South West District meeting at Houston, Tex., April 17–19, 1939. The plant is owned by Howard Hughes, well-known flier and motion-picture producer

Frank Baldwin Jewett—John Fritz Medalist

By KARL T. COMPTON
FELLOW AIEE

The qualifications of the 1939 recipient of the highest American engineering honor are those of a leader, a statesman, and a nobleman of science

AMONG politicians there are few real statesmen, among the aristocracy few true noblemen, among the masses of men few leaders. Ever since I have known Frank Baldwin Jewett I have thought of him as one of that very small group who are the leaders, statesmen, and noblemen of science. I rejoice in this opportunity to say publicly this which I have long thought in private.

Not all leaders are statesmen. Willard Gibbs was a leader in the advancement of science, Beethoven was preeminent as a composer of music, and Mark Hanna was a great politician, but we do not think of them as statesmen. On quite another plane, Cortez in his conquest of Mexico and certain political bosses and racketeers were powerful leaders, but they were not statesmen. Statesmanship implies wise and farsighted leadership toward ultimate social welfare, based on fundamental principles rather than opportunism. Wisdom, energy, and altruism characterize statesmen.

Neither are all statesmen noblemen; for statesmen are not necessarily men of culture, of unselfish consideration of others in their personal relations, of unswerving loyalty to high principles in their personal lives. A father's ambition might be for his son to become a statesman, but a mother's love would hope that he become the kind of a person whom I call a nobleman.

With these distinctions in mind, it is not strange that few men can qualify outstandingly in all three directions. But Frank Jewett has been the leader in building up a great technical and research organization. He has been a statesman in his effective participation in the councils of science, engineering, and industry to make them of the greatest possible benefit to humanity. And he has been so unfailingly loyal and helpful to his host of friends and colleagues, never counting the cost to himself but considering only their best interests, that these friends will assuredly join with me in dubbing him a nobleman.

Frank Baldwin Jewett comes of a long line of New England ancestors, the earliest having settled in Rowley, Mass., in 1632, only 12 years after the landing of the Pilgrim Fathers. These ancestors played active roles in the civil, social, and religious life of New England throughout the colonial days and the early period of the republic. Among his great-uncles was a librarian of the Boston Public Library and a publisher who, among other things, published the first editions of "Uncle Tom's Cabin." My genealogical research has not been carried to the point of tracing the medalist's family connections with the 47 Jewetts appearing in the Boston telephone directory, but it is reasonable to assume that these are living evidence that the prominence of this Jewett family in New England still persists.

Frank Jewett, however, came from the more adventurous branch of the family, which went westward, and still westward to the newer lands of opportunity. His immediate forebears settled in Ohio, at Cincinnati, and then his parents, Stanley P. Jewett and Phebe C. (Mead) Jewett, moved to California. Frank Jewett was born in Pasadena on September 5, 1879.

Professional Education

His first professional education was in the field of electrical engineering at the Throop Polytechnic Institute, which later became the California Institute of Technology, and he graduated with the bachelor of arts degree in 1898. Even then he demonstrated his lifelong interest and faith in fundamental science, and his quality of not being satisfied with less than the best that was possible; for he went for advanced study in physics, mathematics, and chemistry to the vigorous young University of Chicago, to which Professor Michelson had brought especial prestige and opportunity in physics. Here he received the degree of doctor of philosophy in 1902. During his last year at Chicago, he was research assistant to Professor Michelson, who was then developing his echelon spectroscope and building his famous dividing engine for ruling large diffraction gratings. Here also he formed the lifelong friendship with Robert A. Millikan, then an instructor in physics at the university. In the past 25 years there has been scarcely any far-reaching national program in science for human welfare or for national defense but has found these two men as colleagues in the planning and executive councils.

Jewett's final stage of formal education was secured at the Massachusetts Institute of Technology where, from 1902 to 1904, he studied advanced electrical engineering

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Full text of an address delivered at the John Fritz Medal presentation ceremonies during the AIEE winter convention, New York, N. Y., January 25, 1939.

Karl T. Compton is president of Massachusetts Institute of Technology, Cambridge. He was born at Wooster, Ohio, September 14, 1887, and received his formal education at the College of Wooster and Princeton University; many honorary degrees have since been conferred upon him. After serving as instructor at the College of Wooster and Reed College, he became assistant professor of physics at Princeton in 1915, and in 1929 was made chairman of the department. In the following year he was appointed president of MIT. Doctor Compton has been active in the National Research Council and the Science Advisory Board, among other organizations, and is a member of various technical societies. In 1931 he was awarded the Rumford Medal of the American Academy of Arts and Sciences.

and was an instructor in physics and electrical engineering. These were exciting fields in those days, as now. MIT was in close association with the developments in electric power engineering under Elihu Thomson, and the head of the physics department, Professor Cross, was a friend and frequent consultant of Alexander Graham Bell, whose company then had its headquarters in Boston. Of course it is Jewett's innate ability and thorough fundamental training which have brought him to the top of the communications development field, but it was this early association between MIT and the telephone company that gave him his initial direction into it.

In this field of electrical communications, the loading coil had recently been invented and showed promise of greatly extending the feasible range of telephonic communications. The mathematical and physical researches of Doctor G. A. Campbell had proved the enormous advantage of attacking this and similar research and development problems with the aid of the most powerful tools of mathematics and electrical science by men thoroughly trained to use them. Imbued with this conviction, Doctor Hammond V. Hayes, then chief engineer of the American Telephone and Telegraph Company, turned to MIT to find the best possible combination of ability and training, and selected the young Doctor Jewett for an association with the company which has been uninterrupted since 1904.

Doctor Jewett

Advancement in His Profession

To this work, Doctor Jewett brought not only scientific training and ability, but also enthusiasm and a marked gift for organization and administration. To these qualities were added also a remarkable intuitive faculty for sensing the directions of most advantageous experimentation and development. If to these qualities we add his keen judgment of men, ability to inspire loyalty, and the highest integrity, it is not difficult to understand Jewett's steady and rapid promotion to ever more important positions of responsibility.

Within three years after his employment by the company, he was put in charge of the electrical department, and shortly thereafter was made transmission and protection engineer; directing the work which led to phantom loading, and the loading of large-gauge open-wire circuits, and the development of phantom-duplex cables. In 1912 he was made assistant chief engineer of the Western Electric Company in New York, where most of the research and development work of the American Telephone and Telegraph Company was being concentrated. Four years later he became chief engineer, in charge of all scientific development and also the engineering work connected with the manufacturing activities of the Western Electric Company. In 1921 he was elected vice-president and a director, and in the following year he was put in charge of all the manufacturing, sales, and distribution activities of that company in America. In 1925 there was some reorganization of the American Telephone and Telegraph Company and Doctor Jewett became vice-president of that company, and a director of its long-lines department, and also president of the Bell Telephone Laboratories which were then formed as the central research organization to serve the entire system.

The marvelous development of the art of electrical communications within our lifetime is in its major part the product of Doctor Jewett's work, planning, and supervision, aided and implemented by his remarkably able and loyal army of colleagues in laboratory and office. After the loading coil came the vacuum-tube amplifier and its uses in telephony, wireless, and radio. These made possible the transcontinental telephone lines. Permalloy enormously improved the submarine cable lines. Carrier waves enormously increased the carrying capacity of existing lines. Transoceanic telephone communication by radio was established in 1927. The automatic dial system was developed and introduced without confusion. Radiotelephony, wire to wireless broadcasting, sound accompaniment to motion pictures, wire and wireless transmission of pictures, teletypewriters are all new products in wide use, while television and radically new types of transmission lines are among the current developments. Every one of these has, in turn, involved literally thousands of investigations systematically planned for years in advance of a product perfect enough to meet the requirements of public use.

It seems to me that three features uniquely characterize this story of development of an unequalled public service. Firstly, there has been unswerving adherence to the primary subject of electrical communication of information, whether by dot and dash, by word, or by picture. Secondly, there has been steady devotion to the ideal of giving the very best possible service to the public and sparing no efforts to improve this service. Thirdly is a peculiar characteristic of the telephone business: Every new subscriber must be provided with possible connections to every other subscriber; hence the tremendous emphasis on automatic switching, multiple messages over wires, and the like, which alone prevented the costs of universal interconnection from soaring as the number of subscribers has increased. It is now possible for you or me to be connected for speech with about 97 per cent of all the telephones in the world!

Public Services

Turning now to Doctor Jewett's *pro-bono-publico* activities, which have been legion, but a few of the most important ones can be mentioned. He was active in forming the National Research Council, set up by the National Academy of Sciences as a measure of national defense at the request of President Wilson in 1916, and he served for several terms as chairman of its division of engineering and industrial research. As a lieutenant colonel in the Signal Corps during the great war, Doctor Jewett took a leading part in the development of communication devices for both Army and Navy. As one of the most active members of the Science Advisory Board, appointed by President Roosevelt during the severest depression years, he gave particular attention to military and naval problems, to development of a co-ordinated research program for the American railroads, and to the safety of ships at sea in fog. When, in this year 1938–39, the Army Air Corps seeks help on certain technical problems, and the National Resources Committee wants to know what industry is doing in the line of research, of course Doctor Jewett is again called upon for still more service.

That these are only a few among his many public services is indicated by some of his other memberships: policy committee of the National Research Council, past president of the AIEE, British Institution of Electrical Engineers, New York Electrical Society, Society for the Promotion of Engineering Education, American Philosophical Society, Institute of Radio Engineers, American Association for Advancement of Science, American Physical Society, Acoustical Society of America, and American Society of Arts and Sciences. He is a trustee of the Carnegie Institution of Washington, the Woods Hole Oceanographic Laboratory, and Tabor Academy. He is president and trustee of the New York Museum of Science and Industry, and a life member of the Corporation of the Massachusetts Institute of Technology.

Honors and Medals

Naturally this John Fritz Medal is not the first honorary recognition of so distinguished a career. At least nine universities have made him honorary doctor of science, engineering, and laws. He has received the AIEE Edison Medal in 1928, the Faraday Medal of the Institution of Electrical Engineers in 1935, the Franklin Medal of the Franklin Institute in 1936, and the Washington Award last year. From our government he received the Distinguished Service Medal, and from the Japanese government the Fourth Order of the Rising Sun in 1923 and the Third Order of the Sacred Treasure in 1930.

I have sketched Doctor Jewett's career, mentioned some of his public services, and listed some of his honors. I have not mentioned, on the more personal side, the multitude of friends and colleagues whom he has helped by advice and example. Many have had experiences similar to my own. I have gone to him in perplexity over some personal problem and come away with clarified vision and courage. It is for this reason that I am especially grateful to have had this opportunity to say these words about my friend and colleague, Frank Baldwin Jewett—leader, statesman, and nobleman of science.

Illumination Notes*

Conditioned Reflex and Traffic Lights. When through experience a new stimulus becomes effective to produce automatic response, the neural mechanism producing it is called a conditioned reflex. Pavlov produced conditioned reflexes in dogs by associating for them the ringing of a bell or tapping on the skin with immediately thereafter receiving food. After such conditioning of reflexes, the bell or the tapping would suffice in itself to produce a flow of saliva. In driving an automobile, the shift of the right foot from accelerator pedal to brake pedal, or vice versa, as traffic conditions call for deceleration or acceleration, becomes almost automatic and largely unconscious. The introduction of traffic lights created a new stimulus to that response and thus a conditioned reflex.

Now Pavlov found that by creating a second conditioned reflex, antagonistic to the first, the dog could be made highly nervous, and soon would lose all conditioned reflexes. Howard B. Fabing, in a report published in the *Journal* of the American Medical Association, in September 1938, points out that traffic lights result in just such a collision of conditioned reflexes. A driver approaching a traffic light showing green, and so proceeding under the "go ahead" stimulus, may find it suddenly change color and receive a quick conflicting stimulus; or, even if it does not change, he knows by experience that a change is possible. The report shows that this collision of conditioned reflexes does result in nervous strain, through an "anxiety neurosis in miniature," followed by a bodily reaction of exhaustion.

The realization, shared by most engineers, that present traffic signals are far from perfect, is strengthened by this showing that they are psychologically bad, and this should lead to increased striving after improvement. In the meantime we must perforce endure the lesser evil of collision of conditioned reflexes to escape the more serious disaster of frequent collision of cars.

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* Contributed for the AIEE committee on production and application of light by L. A. Hawkins (A'03, M'13) executive engineer, research laboratory, General Electric Company, Schenectady, N. Y.

Graduate Training for Engineers

By L. W. W. MORROW
FELLOW AIEE

Questioning the value and adequacy of postgraduate engineering courses as commonly conducted, this article tosses a verbal bombshell into the laps of educators. A symposium of solicited comments reflecting the opinions of representative industrialists and engineering educators is scheduled for presentation in the next issue; other brief comments are invited.

WHAT BASIS is there for proposing to give graduate training to engineers? Does this program originate in response to the demands of industry or does it spring from the minds of engineering educators? What facts justify a student in enrolling for graduate work or warrant an engineering college in embarking upon this expensive and difficult undertaking? These questions are pertinent to a discussion of graduate training for engineers.

A study of the market for engineers who have taken graduate work leads to the conclusion that industrialists offer no earmarked inducements to men who take this training and do not think that it would be profitable to employ them. One reason for this condition is that engineers with graduate training have no establishment or position as a professional group in industry. Another is that industrial leaders have not thought about this type of engineer and have had insufficient experience with them to formulate practices and policies. Only executives of a few large corporations, whose activities are based upon advanced technology, have considered such a program and most of these doubt the competency of the colleges to give adequate training. They prefer to hire four-year graduates and then develop them in their own organization. The majority of managers say the specifications for training are so varied and the number of men needed so limited that it is inadvisable for the colleges to undertake the work.

Some specific comments are given: A director of research and development in a large manufacturing company says, "It is foolish for engineering colleges to give graduate work. We need a few men with advanced training each year and select them from the doctors in mathematics, physics, and chemistry, and even here we pick those who have made specialized studies in particular fields of science. Engineering colleges would have to revise their undergraduate as well as their graduate curricula to produce men with an equivalent knowledge and training in the time available. We need graduate scientists but not graduate engineers."

A manager of a large engineering department concerned with the design and development of complicated machines says, "We do not need postgraduate engineers. Most of the four-year students we get now are so theoretical and impractical that we find it difficult to break them in. Let the colleges give a better undergraduate course before they undertake graduate work."

Another comment is by a director of engineering: "We doubt the ability of the colleges to give graduate work that would help men in their work with us. We prefer to take four-year men and train them by having our own specialists teach them the theory and practice involved in the technological aspects of our business. No college teacher could keep up-to-date on developments or have the data and facilities that our specialists have at hand. In my opinion it would be a waste of time for the colleges to give graduate training."

An engineer who is president of a large enterprise says, "I believe it would be a good thing for the engineering colleges to give graduate training to a limited number of high-grade men. But I do not think this graduate work should be entirely in engineering and science. We need men in industry with a training that will enable them to solve management, financial, and public relations problems, and I think the four-year engineering students with their technological background and with a method of attack peculiar to engineering offer the best possibilities for developing into leaders of industry if given a well planned graduate training." Other comments may be had in many quarters supporting the conclusion that the present market for graduate engineers is limited and highly specialized.

We cannot agree, however, that these comments are competent or conclusive. There is a broader perspective and a greater depth of thought to be applied than are exhibited within the narrow compass of these individual opinions. Yet, if these are the opinions of employers, why do the engineering educators wish to institute graduate work? Possibly their reasoning is based largely upon the infiltration of so-called cultural courses in the undergraduate curricula and the great depth and scope of technological knowledge now recorded and now needed by engineers in industry. These educators believe that more time must be devoted to training a limited number of specially qualified students so that they may be able to do more competent and more fruitful technological work in industry.

Some engineering educators have an idealistic concept for graduate work; they see the need of society for a highly trained and a broadly trained man to lead the nation toward a better way of living and a better conduct of national affairs. They base their program for graduate training on possibly too ambitious an idea of the place and the competency of the engineer in modern life.

Full text of an address delivered before the Society for the Promotion of Engineering Education, New York, N. Y., December 10, 1938.

L. W. W. MORROW is western editorial director of McGraw-Hill publications, with offices at Chicago, Ill., and formerly was manager of the fiber products division of the Corning Glass Works, Corning, N. Y. A biographical sketch of Mr. Morrow appeared in the February issue, page 91.

Perhaps the best approach to finding the background for the ideas of engineering educators about graduate training is to study their present operations. A glance at the catalogs of the engineering colleges, a study of the number of students and the courses they take, and an observation of the faculties and equipment devoted to graduate work leads to several conclusions as to the caliber and scope of present graduate work and its adequacy for training men to meet the present needs of industry.

The usual graduate curricula is made up of several courses in specialized engineering fields with options in other departments. Accent is placed upon technique and practice in engineering and the endeavor is to impart skill similar to that involved in practical engineering work. Because of a hobby of a professor or specialized ability, there is a tendency toward a specialization or unbalance in the graduate curricula. Often, also, experimental facilities are focused only on one major problem in research or engineering. Very few courses are given in the fundamental sciences and these are seldom taught by the best teachers in the science and engineering faculties. Examples are numerous of the endeavor to put knowledge into unco-ordinated tidbits already too prevalent in the undergraduate curricula, and to have the graduate curricula either made of assorted electives or focused upon intense specialization. With few exceptions, graduate engineering work is part of the catalog scenery and many courses are never taught. Some few schools, however, in certain branches of engineering and in a special fields, have done notable work and achieved a reputation for graduate training of a specialized character.

As a general conclusion we may say that present graduate work is without completeness or unity in plan or policy; is taught by overworked or incompetent teachers; is without adequate experimental facilities; has relatively few students enrolled; and only a few of these are qualified to do the work. We have few reasons to base plans for graduate training upon present experience and practice. There are sound reasons, however, for studying the present situation and building upon the good things found in past experience.

Objectives for Future Plans

There is no need to delve further into the market demands for graduate engineers or to make a detailed analysis of present curricula. We do not believe anyone will discuss the topic from these points of view except to point to a vastly superior development. Discussion must be based largely upon opinion and speculation about what should be done and about what can be done in the future.

As good engineers, we should start with the naming of objectives and the reasons for these objectives. We can generalize by saying that the world needs men with a more thorough training in the sciences and in the humanities so as to contribute to national well-being. We can restrict ourselves to the technical aspect and say that a man thoroughly grounded in science and engineering is needed by industry. We can point to the trend of undergraduate engineering to become a training for business and this consequently necessitates selectivity in engineering education and more time for training those who are particularly well fitted to become professional engineers. Possibly we weigh all these factors and believe graduate training for engineers is necessary for any or all of these reasons. But there are more specific service reasons for giving serious consideration to the amplification and improvement of graduate training.

If we are going to raise the standards of civilization, it must be through the use of technological levers that create more wealth and more goods and services. And it is apparent that technological advances today will not come from individual inventors or mechanics or engineers in sufficient volume or at a rate to satisfy the needs of the times. They must come through the work of well-prepared engineers and scientists who apply principles and use a technique far in advance of that used by rough-and-ready inventors or even by four-year engineering graduates.

Most industries are staffed with technical men who can carry on present activities and who can do the things that make for greater efficiency and more economy, but the big advances lie in fundamental and long-continued researches by exceedingly well-trained men. It is found frequently that two or more years of research and an expenditure of millions of dollars are involved in the development of new processes and new products in any branch of industry. It is found that an initial delving into pure science is the base for later applying engineering knowledge and methods to get commercial production.

If we can increase the number of men qualified to do this work and industry can be induced to hire them and to give them a chance to use their knowledge and ability, there is every reason to count upon their making marked advances in industrial progress and consequently raising our national standards of living.

It is the chief idea of those who advocate graduate training that men of this type and caliber are needed and can be trained and that the engineering method and approach is the best to use in their development. They apply the fundamentals of science but should be engineers in training, thought, and action.

There is a realization that the men now most active on the advance fronts of industry are the doctors in physics and chemistry. Their knowledge of science enables them to go forward from the present positions in accord with principles which bring tangible results in the shortest time and with maximum economy.

The idea of the engineering educators is to teach fundamental science by the engineering or applied method in order to turn out a better type of man to do this work than is now found available. To put it bluntly, engineering educators believe they can produce a superior product to that produced in the academic schools of science so far as the measure of competency is the ability to do the technological work now required to advance the status of industry.

It is not the thought that present graduate training as given in pure science would be duplicated, nor would it be wise for engineering educators to institute college training in specialized fields of engineering practice; their goal should be to give a rounded and integrated course in the fundamental sciences by using the engineering or applied method of teaching. By having greater unity, a better educational method, and a more focused objective than can be found in the science departments of our universities, these educators believe that teaching science by the applied method will give a better training to the type of man needed in our technological world.

Perhaps this thought is incorrect. Possibly the pure scientists will say that the initial research work should be done by them and that the engineers should then be called upon to carry the results to commercial stages. If true, this would give an entirely different specification for graduate training in engineering.

And if we analyze the kind of problems to be solved in industry, we can get an idea of the training to give men that will aid them to get solutions. Any study of the technological aspects of industry shows that advances can be made best by men who are up-to-date in all present scientific knowledge and principles and who are sufficiently skilful to apply this knowledge in unknown areas for utilitarian purposes.

Need for Co-ordination of Knowledge

It is not enough to have training in method of attack and a knowledge of principles. There must be a finite knowledge of gases, liquids, solids, organic and inorganic materials, light, heat, sound, and electricity. There must be a supplementary knowledge of mathematics, thermodynamics, metallurgy, mechanics, hydraulics, electronics, and other subjects to motivate and focus the abstract scientific knowledge. Above all, there must be a co-ordination of knowledge and principles in order that these men may work intelligently.

The man needed by technological industry must be able to state his variables at the start of a problem, weigh their relative importance, predict their changes under changed conditions, put them together according to a planned program that is based upon a theoretical analysis and solution, and apply skill and technique to bring about a tangible answer. And, in these problems, there will be one or more variables that are impossible to evaluate by means of present knowledge; consequently, the engineer must have the ability to explore the unknown. Here again only recorded knowledge and broad principles of science are the tools available for him to use.

It may be that this specification assumes too great a scope for engineering because it is impossible to train such a man in any reasonable time. Experience seems to indicate that specialization instead of generalization is the only practicable educational procedure and that the problems of industry are best solved by the joint actions of specialists in science and engineering. But there is doubt as to the validity of this conclusion simply because the broader and better conception has not been tried. We could well discuss this alternative as it offers a relatively easy path to the goal, but it is not so logical or so theoretically effective as the endeavor to give adequate training to each individual.

This is the ideal specification for graduate training and, if the engineering colleges can fill it, rapid and major advances in technology can be counted upon to occur. This is an ambitious program to undertake; especially since the number of men that will be taken by industry in the near future at a premium wage will be limited and the cost to the colleges will be high. It is doubtful, moreover, that more than a half dozen colleges can get or now have the faculties, the facilities, and sufficient funds to give the training desired. But the opportunity to do this pioneering educational work is here and surely a few leaders will be found willing to try so that all may benefit by actual experience.

It seems practicable and best to initiate this work in some universities through the co-operation of the faculties in science and engineering. Few, if any, engineering colleges are sufficiently self-contained as to teaching staff and experimental equipment to undertake such a broad and such a thorough training as is proposed.

Since students should be selected, upon the basis of their aptitude and ability, from graduates in both science and engineering, the co-operation of the respective faculties would have other advantages. The possible sacrifice of some good elements in the engineering method of instruction would be offset by having a more competent staff and a going organization to do the work. We stress too greatly the merits of the engineering method of teaching when we deal with the more mature men and superior minds presumed to be available for graduate training, and probably a composite of academic and engineering teaching would give good results. Engineers allege that the pure scientists are academic and impractical but the scientists in turn say that the engineers are superficial and equip students only with current skills and practices. There is enough truth in both assertions to point toward a successful compromise in using a joint faculty to train the men suggested.

If the basis for graduate training is the mastery of science and mathematics, then the best men on the faculties of the schools of chemistry, mathematics, and physics should be used to give instruction. But this should be done in co-operation with the engineering faculty and the method of instruction should be modeled largely upon that used in engineering teaching in order to get a co-ordinated curricula in applied science.

A joint faculty made up of engineering and science teachers could work out the composition of a curricula with details of the courses that would permit a splendid graduate training. The first thing to do is to define the scope and objectives of the training, and in doing this the counsel of the scientific faculty and of industrial specialists is valuable and essential. The establishment of procedure and course content can be worked out next to achieve the objectives. The teaching should incorporate the engineering methods of attack and experimentation to give definiteness to the application of principles as well as to fix them so that they may be used as tools for engineering research.

The fundamental handicap to the development of graduate training is the faculty. We know that most engineering faculties are overloaded now. We know that the specifications for a teacher of this kind of graduate work are so severe that few can qualify. We know that the type of teacher needed is now so eagerly sought by industry to do its work that colleges cannot meet the competition. But there are a few who like to teach and who are not tempted by salary who can form a nucleus, and, if the movement grows, it is logical to assume that much of the research work of a fundamental character now done by industry will be done in the colleges. If the colleges earn a position, undoubtedly their graduate work will be supported and they will have the teachers needed. Initially, however, the great need is for a faculty able and numerous enough to carry on both graduate and undergraduate teaching.

It will not be sufficient to take present courses in engineering, science, and mathematics and put them together to make the curricula. The result would be an artificial and unco-ordinated group of courses without unity or plan. There must be devised new courses that fit together to make an integrated whole. It will be just as difficult to reverse the present trend to put knowledge into specialized cubbyholes in engineering as it will be to do this for arts and science courses. Both planning and patience must be exercised if we wish to reach the objectives, and the curricula is the agency to do the work.

Engineers complain that mathematics is now taught in a group of artificial divisions rather than as a subject that has unity and completeness, but the same thing may be said of any curricula in engineering, with possibly the most glaring example in the present tables and groupings for teaching undergraduates in the several branches of engineering. There is need to get unity and breadth in both graduate and undergraduate curricula and to call a halt on the tendency toward a detailed separation and specialization in both science and engineering. The man most closely approximating the ideal to be sought by engineering educators is the type of scientist developed by the British educational system of a few years ago. But the depth and area of knowledge has increased so greatly since those days that some may say this type of education is impracticable for the limited time available. It would be more accurate to say that the influence of the German school of education through specialization still dominates our American universities.

If, however, we cannot train a man to have the adequate breadth and depth of knowledge in the time available, then of course we must make some measure of departmentalization in curricula. This would necessitate the use of several men in a group for attacking a single problem in industry because of the limitations of the educational system, but this is the method now prevalent in industry and is a practicable procedure. But we should first endeavor to train a rounded and not a specialized man by use of a single unified curricula. One man is always more effective than a committee to do work in this world.

Graduate engineering courses should not stress engineering practices or skills on one hand or endeavor to develop detailed specialization in pure science on the other. Nor should they require large expenditures for laboratories to be equipped with full-size engineering equipment; the laboratory work should be used to fix and illustrate principles and this requires precise measurement and first-class experimental technique rather than an experimental approach to engineering operation and practice.

The ideal man produced by this graduate training should be a master of the sciences, a master of mathematics, expert in technique, and skilled in the engineering approach to the solution of problems. He should have the ability and the enthusiasm to do new and difficult feats in industry. Such a man must devote at least four years to graduate study but his work would then be so outstanding in industry that his personal reward would be abundant and his services in constant demand.

As time goes on and the situation develops in each institution, the educational program should be to build a complete and unified faculty within the college of engineering. This would improve the graduate work and would put a needed element of breadth, depth, and quality into the present undergraduate curricula.

Even today, careful consideration should be given to incorporating the departments of science and mathematics with the college of engineering or preferably a new college of technology. There is a common ground in engineering and science not present in the hodge-podge setup now called the college of arts and sciences. Both science and engineering would benefit from a closer affiliation. There would be a more general use of a competent faculty and amplified facilities for research and experimentation. There would be more unity in policies and in educational methods. But this unity should not destroy the independence or enthusiasm of the men in pure science on one hand or eliminate the essential elements of engineering on the other. Both groups could, however, stand a little modernization and integration and would be better if administered as a unit in university organization. Departmental barriers, whether in science or in engineering, are now major handicaps to effective education.

In building graduate work there should be no tendency toward uniformity or regimentation as between colleges. The individual situations as to location, facilities, and faculty talents should be capitalized upon both as a practical procedure and as an endeavor to work out experiences and practices for the benefit of all.

Generally speaking, it would be well for the graduate faculty to be associated intimately with industry in meritorious industrial research and specialists in industry should be called upon to co-operate in the graduate training. This intimacy would work toward a mutually advantageous relationship between industry and the colleges, would create an invigorating atmosphere for the students, and would bring new and vitalizing information to the curricula. Much of the knowledge required in graduate training is not in textbooks and the method or procedure in training follows closely those used in industrial research.

It is doubtful that the usual classroom textbook method of education is at all satisfactory for use in graduate training and educators should strive to teach by use of projects and actual research problems which mostly can be supplied by industry itself.

It may be noted that technical training is stressed as paramount in engineering graduate work at this time. There are two reasons for this. The first is that technical contributions give the best tools to improve our industrial civilization and these can be made under a practical and organized plan to train men. The other is that it is difficult, if not impossible, to give co-ordinated work that will include technical and nontechnical subjects in a limited time and under the conditions now encountered in our universities. Possibly a curricula in science, engineering, economics, sociology, history, and literature can be improvised and used, but it would be of doubtful effectiveness unless radical changes were made in university organization and procedure to knit together these courses into some degree of unity in scope and treatment. Any mere dilution of the technical curriculum with unco-ordinated electives in arts, business, or law violates the specifications for training the type of man needed and cannot be accepted as a part of an effective educational plan for the development of professional engineers.

Most of us would like to see some integrated course on the evolution of society and of industry and the relations and interrelations of technology, law, business, and sociology in their effects on civilization as a part of the education of all engineers. We would like to develop in each student a perspective on national affairs, a sound philosophy of life, and the ability to weigh his work in social terms. Possibly this can be done in time, but at present the engineering colleges can and should stress the technical aspect of graduate training. We should have faith that the utilitarian contributions of graduates to society will be assimilated and act as catalysts to cause each of us to bask in that better way of living we all desire.

A very different type of graduate training should be planned for the education of those who expect to be political, financial, or moral leaders and in this training, while necessary, the engineering faculty should be relegated to a secondary position.

We may say that the engineer by training, by experience, and by temperament is fitted to solve the social and economic problems of our civilization but this competency is not granted by others and there is no proof that the statement is true. In fact, the available evidence is against engineering as a preparation for leadership in public affairs. There is a positive danger, therefore, that this premise about the ability of the engineer may be used to set up programs for training young people to bring salvation to civilization. There are no data to warrant the establishment of such training on the premise that it would be likely to improve upon the results of the training in sociology, history, economics, law, and religion now used to develop leaders for directing national affairs. We should put this kind of a program on a trial basis, of course, but this discussion is held to the practicable and tangible opportunities in graduate training for engineers at this time. Undoubtedly some part of the curricula should also be given to training in nontechnical subjects but this is a minor consideration in this discussion. We now have the data and the knowledge to establish a system of training by use of engineering technique and scientific knowledge that will produce men who we know can contribute definite and needed things to technological progress. This should be the primary objective in graduate training.

Some day we hope the engineer will understand the thoughts of men, will sense human preoccupations and sentiments, will interpret facts to disclose truths and feelings that are deeper, and will combine desirable personal traits with his logic, his systematic attack, and his individualistic philosophy of life to be a competent leader of mankind, but I doubt the ability of the engineering colleges to train such a man through any particular curriculum, especially since the influence of character, background, and environment have such potent effects upon mental processes and human reactions.

As stated in the beginning, a discussion of graduate work must be based upon a study of present and past conditions and then projected into the future and into the realm of opinion. The outline presented here is largely a personal opinion by an incompetent observer. It is idealistic, perhaps, but it is designed to produce the desired results and to create a discussion that will no doubt differ with these conclusions.

In my opinion the answer to the proposal to institute graduate work requires a great deal of study before competent conclusions may be drawn. Such a study must cover the entire scope of engineering education and the objectives to be sought. We now have proposals that engineers should have a five- or six-year undergraduate course.

It is now agreed by educators that the present undergraduate curriculum is formed so that engineering training will be focused upon a preparation for life or for business and not for professional engineering. Some radical suggestions are made that a general course as a preparation for business be given and specialized technical courses be given to a few students who show aptitude for becoming technical engineers.

In my opinion, a study of engineering education as a whole is needed to point to the best way to give graduate training and to fix the graduate curricula. There is a possibility that a reorganization of the undergraduate curricula to permit of selectivity with respect to the few men competent to take the kind of graduate work proposed may permit of adequate postgraduate training in two years instead of four. It may even seem advisable to stop at the end of four years of undergraduate work if selectivity and technological specialization can be had in college and if industry will then co-operate in developing these men when they join commercial enterprises.

This discussion, it is hoped, will start a program of investigation rather than develop conclusions about postgraduate training. Properly sponsored investigations should be conducted by committees made up of the best men in science, engineering, and industry both within and without the ranks of the educators. We hope such a study will support the idea of graduate training of the kind proposed, but we are the first to agree that no action should be taken until facts are assembled to support opinions. Our critical times and changed conditions offer every possible inducement to engineering educators and to industry to train and to equip our young people to meet the needs of civilization to better advantage.

News

Of Institute and Related Activities

Enlarged Winter-Convention Program Results in Increased Attendance

WITH a technical program enlarged to include 17 sessions, at which 82 technical papers were presented, two general sessions, and five technical conferences, the AIEE 1939 winter convention held in New York, N. Y., January 23–27, closed with a total registered attendance of 1,610—the highest since 1924. This enlarged program, together with the careful planning and execution of the program as a whole on the part of the hard-working winter-convention committee, is believed to be largely responsible for the increased attendance. More detailed statistics on registration and attendance are given in accompanying tabulations. Included on the program were the usual entertainment features and inspection trips. A special evening program was devoted to presentation of the Edison and John Fritz medals to Past Presidents D. C. Jackson and F. B. Jewett, respectively.

Since all technical papers and related discussions ultimately will appear in the TRANSACTIONS, no reports have been published here on the technical sessions. Reports of other major events may be found on succeeding pages and elsewhere in this issue.

GENERAL SESSIONS

As previously announced, one of the two general sessions featured an address by the noted economist, Virgil Jordan, president of the National Industrial Conference Board, Inc.; the other was devoted to a discussion of the damages caused by the New England hurricane of September 1938 and the engineering conclusions that might be drawn from the experiences of various utility systems in the affected area. Discussions of the damages caused by the storm and of the experiences of the utilities were presented by six scheduled speakers (the essential substance of these six presentations appears elsewhere in this issue). Following the scheduled discussions, the meeting was concluded by informal discussions from the floor. H. S. Osborne, chairman of the technical program committee, presided at the hurricane session.

The other general session was opened by T. F. Barton, chairman of the winter-convention committee, who presided throughout. He first introduced Chairman-Elect C. A. Andrews of the AIEE San Francisco Section, who urged all those present to attend the combined AIEE summer and Pacific Coast convention to be held in that city June 26–30, 1939. Following Mr. Andrews' remarks, President John C. Parker spoke on "The Engineer's Social and Political Relations"; full text of his address appears elsewhere in this issue. At the conclusion of President Parker's remarks, the feature address of the session, "Enterprise and Social Progress," was delivered by Doctor Jordan; a manuscript embracing the substance of this address is expected to be made available for publication in a subsequent issue. A discussion period during which Doctor Jordan answered questions from the floor brought the session to a close.

Analysis of Registration at Recent Winter Conventions

District	1936	1937	1938	1939
New York City and foreign (3)	697	629	767	752
Middle Eastern (2)	222	216	292	404
North Eastern (1)	219	222	252	287
Great Lakes (5)	43	38	74	76
South West (7)	11	12	18	37
Canada (10)	11	17	14	28
Southern (4)	15	21	11	16
Pacific (8)	4	7	5	4
North West (9)	3	1	3	2
North Central (6)	6	2	2	4
Totals	1,231	1,165	1,438	1,610

Attendance at Special Features of Recent Winter Conventions

Feature	1937	1938	1939
Total registration	1,165	1,438	1,610
Smoker	1,175	1,201	1,264
Dinner-dance	500*	651	527
Inspection trips	926	1,012	1,167

* Estimated.

ENTERTAINMENT AND INSPECTION TRIPS

As usual, the principal entertainment features of the winter-convention program consisted of the annual dinner-dance and the annual smoker. Attendance at the smoker broke the record set last year with a total of 1,264; attendance at the dinner-

Attendance at Sessions and Conferences

Time		Attendance
Technical Sessions		
Monday		
10:00 a.m.	Relays	200
10:00 a.m.	Selected subjects	100
2:00 p.m.	Protective devices	215
2:00 p.m.	Transportation	175
2:00 p.m.	Electronics and industrial power applications	85
Tuesday		
9:30 a.m.	Symposium on rating of electrical machinery and apparatus—I	210
9:30 a.m.	Communication—I	90
9:30 a.m.	Switching transients	175
2:00 p.m.	Symposium on rating of electrical machinery and apparatus—II	150
2:00 p.m.	Communication—II	200
2:00 p.m.	Power generation	240
Wednesday		
2:00 p.m.	Symposium on rating of electrical machinery and apparatus—III	175
2:00 p.m.	Power transmission and distribution	210
2:00 p.m.	Electric welding	85
Thursday		
9:30 a.m.	Cables	185
9:30 a.m.	Basic sciences	35
9:30 a.m.	Instruments and measurements	125
Technical Conferences		
Monday		
10:00 a.m.	Sound	125
4:00 p.m.	Electronics	*
Tuesday		
2:00 p.m.	Definitions	*
Wednesday		
2:00 p.m.	Network analysis and synthesis	*
Thursday		
9:30 a.m.	Teaching of communication engineering and electronics	100
General Sessions		
Wednesday		
10:00 a.m.	Enterprise and Social Progress	275
Thursday		
2:00 p.m.	Experiences from the New England hurricane	381

* Not reported.

Analysis of Registration at 1939 Winter Convention

Classification	Dist. 3	Dist. 1	Dist. 2	Dist. 4	Dist. 5	Dist. 6	Dist. 7	Dist. 8	Dist. 9	Dist. 10	Foreign	Totals
Members	660	251	345	13	63	3	36	3	1	23	2	1,400
Men guests	42	20	34		10	1	1	1	1	3	1	114
Women guests	47	16	25	3	3					2		96
Totals	749	287	404	16	76	4	37	4	2	28	3	1,610

dance totaled 527. As usual, there was a special program of entertainment events for the women guests.

Inspection trips to a variety of local points of interest rounded out the "extra curricular" portion of the program. As in recent previous years, the last scheduled day of the convention was devoted entirely to inspection trips; there were also trips on other days of the convention. Attendance statistics are given in accompanying tabulations.

Directors and Committees Meet

In accordance with the usual custom, the AIEE board of directors met during convention week. The national nominating committee also met, in accordance with the Institute's bylaws, to select nominees for election to Institute offices for the year 1939–40. Reports of both these meetings are given in succeeding pages.

Meetings of the following Institute committees also were held during winter-convention week: automatic stations; basic sciences; communication; electric welding; electrochemistry and electrometallurgy; instruments and measurements; Lamme medal; lightning arrester subcommittee; membership; planning and co-ordination; power generation; power transmission and distribution; protective devices; research; safety; Sections; technical program; transformer subcommittee; and transportation. Following the custom established several years ago, the committee on Student Branches held a luncheon for Branch counselors attending the convention, which was followed by informal discussions. Brief reports of some of these meetings are given in succeeding pages.

Registration for Inspection Trips

Trip	Registration
Sponsored broadcast, General Electric Company, NBC Studios	50
Columbia University cyclotron	57
Fluorescent-lighted railroad car and portable battery-charging rectifier—New York Central Railroad Company	50*
Sponsored broadcast, Consolidated Edison Company of New York, Inc., NBC Studios	46
Jacob Ruppert's brewery	35
Electric ferry and fireboat—City of New York	35
Automatic substation—Interborough Rapid Transit Company	31
Lamp works, elevator factory, and meter works—Westinghouse Electric and Manufacturing Company, Bloomfield, Jersey City, and Newark, N. J.	102
Essex generating station, Public Service Electric and Gas Company, Newark, N. J.	19
Electrical Testing Laboratories, New York, N. Y.	57
New York Stock Exchange	47
Western Electric Company cable and apparatus plant, Kearny, N. J.	89
Sponsored broadcast, Cities Service Company, NBC Studios	100
Newspaper plant, *Daily News*, New York	59
Trip to World's Fair	40
Museum of Science and Industry	250*
Television tour, Radio City	
Observation roof, Radio City	
Broadcast tour, Radio City	
Hayden Planetarium	100*
Total	1,167

* Approximate.

Winter-Convention Committee

The committee responsible for the success of this year's convention consisted of: T. F. Barton, *chairman;* G. E. Dean, E. E. Dorting, F. M. Farmer, L. C. Miller, H. S. Osborne, J. H. Pilkington, A. L. Powell, C. S. Purnell, George Sutherland, and W. W. Truran. Committees in charge of special events were as follows:

Dinner-Dance. T. S. Bacon, *chairman;* K. F. Bellows, Tomlinson Fort, S. B. Graham, F. G. Guldi, J. L. Holton, Thomas Maxwell, S. A. Smith, Jr., P. W. Spence, and F. Van Olinda.

Smoker. D. W. Taylor, *chairman;* A. J. Cooper, P. G. Fredericks, William Jordan, J. E. McCormack, J. H. Moore, E. G. D. Paterson, T. D. Reimers, W. H. Rogers, B. J. Rowan, M. L. Waring, E. E. Wolff, and W. R. Van Steenburgh.

Inspection Trips. R. F. Brower, *chairman;* C. L. Chatham, C. F. Fowler, R. M. Kime, H. G. Life, L. A. Nelson, R. R. Peatfield, and Henry Vidal.

Women's Entertainment. Mrs. A. F. Dixon, *chairman;* Mrs. T. S. Bacon, Mrs. T. F. Barton, Mrs. C. R. Beardsley, Mrs. R. F. Brower, Mrs. H. C. Dean, Mrs. F. M. Farmer, Mrs. Tomlinson Fort, Mrs. A. H. Kehoe, Mrs. H. S. Osborne, Mrs. A. L. Powell, Mrs. G. S. Rose, Mrs. W. R. Smith, Mrs. George Sutherland, Mrs. D. W. Taylor, and Mrs. H. R. Woodrow.

Sections Committee Met During Winter Convention

Among the various AIEE committees that held meetings during the Institute's recent winter convention was the Sections committee. Through the efforts of H. H. Race and M. S. Coover, respectively chairman and secretary of that committee, this brief report of the meeting has been made available.

Actions taken by the Section committee since its meeting in Washington, D. C., on June 20, 1938, were first summarized. Among these actions were:

1. Extension of territory of Muscle Shoals Section to include Marshall and Madison Counties in Alabama.
2. Extension of territory of San Francisco Section to include six counties in Nevada (Washoe, Ormsby, Storey, Lyon, Douglas, and Mineral).
3. Formation of an AIEE San Diego (Calif.) Section (report of organization meeting appears elsewhere in this issue).

AIEE President John C. Parker spoke briefly on Section activities. He called attention to the need of "some better method for determining the identity of students graduating and entering the profession in order to hold them in touch with the Institute." He mentioned also the difficulty that the young men in the Institute find in making acquaintance with the older men. It was reported that some Sections solve this problem by appointing younger members on each of the Section committees, thus drawing them into contact with the older members and inducting them into Institute activity. All Sections were urged to use this method as far as may be practical.

Concerning members residing in territory not now assigned to any Section, the general policy was endorsed that wherever practicable the members in such territories should receive notices from and be made to feel a part of the Section nearest to them. In large areas such as the states of South Carolina and West Virginia, Sections should be formed as early as there is sufficient local interest and justification. In smaller areas such as groups of counties in Maine, New Hampshire, Vermont, and Pennsylvania, the chairman of the Sections committee was empowered to consult with the vice-president and Section officers concerned to allocate to the nearest Section such auxiliary territory.

Chairman Race presented a chart summarizing the information received on Section activities, in response to his letter of December 27, 1938, which was addressed to all Section chairmen. The object of this effort is to inform all Sections on the projects that have proved most interesting and helpful. The suggestion was made that the Sections committee undertake the preparation of a pamphlet summarizing these numerous and diverse activities so as to make available to incoming Section officers a background of experience of all Sections.

Chairman W. C. Kalb of the Cleveland Section reported that a division of that Section had been formed at Mansfield, Ohio, under the leadership of C. A. Faust (announced in the January issue). He reported also that the interest and number of members are such that plans now are under way for formation of a Mansfield Section.

A report on the status of the licensing of professional engineers was presented by C. R. Beardsley, chairman of the Institute's special committee on model registration law. He said that the National Council of State Boards of Engineering Examiners had invited the Institute to co-operate in the formulation of examinations for candidates for license; also that the AIEE board of directors had authorized funds for the printing and distribution to Section officers of copies of the latest revision of the model law. W. H. Timbie, former chairman of the Sections committee, was appointed to represent the Sections committee in this project.

Student Branch Committee Met During Convention

An open meeting to discuss matters related to AIEE Student Branches was held during the Institute's recent winter convention in New York, N. Y. This brief report of the proceedings was made available by Chairman R. W. Sorensen of the Student Branches committee.

Although attended by only three committee members, the total attendance was 52, representing 36 engineering colleges and several industries that have training courses for college graduates. The geographic regions were practically all represented, as was nearly every type of engineering college. Many of those present took active part in discussing the several questions up for consideration, and numerous valuable suggestions were contributed.

By practically unanimous action the assembled group voted to recommend the following program:

1. The booklet "The Electrical Engineer" should be issued as soon as possible, and a committee of

three should be appointed to carry out this instruction.

2. Henceforth Student Branches shall be authorized only at colleges whose electrical-engineering curricula are accredited by Engineers' Council for Professional Development, but no retroactive action shall be taken regarding Branches established before the accrediting plan was put into operation.

3. Recommended that a change be made in method of grading student papers from the one now in operation to the one recommended by AIEE District number 1, which has been set forth in E. M. Strong's letter of February 7.

4. Recommended that the proposed Chas. F. Scott memorial celebration be promoted for the Branches next year. Chairman Sorensen was authorized to appoint a committee of three to investigate the possibility of having Doctor Scott prepare a talking record for distribution to Student Branches to be used during the year.

5. There was much discussion about ways for presenting activities of the Institute to students, the best suggestion being that made by A. C. Stevens: that Institute vice-presidents be urged to give more attention to visiting Branches. This seemed particularly pertinent because inquiry brought forth the statement that very few vice-presidents had consistently made Branch visits, although occasionally some vice-president in several of the various Districts during his term of office did make it his business to visit the Branches in his region.

With the meeting open for other suggestions, the following were presented:

1. That consideration be given as to what to do about inactive Branches.

2. That Branches be invited to make nominations through counselors and officers for candidates for Eta Kappa Nu awards.

3. That student sessions be carried on more frequently in conjunction with national conventions.

4. That the noon open Student Branch committee luncheon be made continuing in connection with the winter convention.

The committee appointed to reissue the booklet "The Electrical Engineer" is composed of the chairman of the Student Branches committee, National Secretary H. H. Henline, and H. H. Race.

AIEE Committee on Safety Reports Recent Activities

By action of the AIEE board of directors during the year 1937–38, the functions of the Institute's committee on safety codes were expanded and the committee on safety created to include the entire field of safety in electrical engineering. This report of the current progress of that committee has been prepared by W. C. Wagner, committee secretary.

The committee in letters has endeavored to interest universities, and in particular their electrical-engineering departments, in the matter of accident prevention and including instruction in the proper method of resuscitation from electric shock, asphyxiation, and drowning. Suggestions have been included that other departments of the universities may also be interested in the subject, with emphasis on instruction to all students, particularly because of the frequent occurrence of such accidents outside of university laboratories. Such training among the electric and gas utility companies has resulted in the saving of the lives of many persons who have accidentally come in contact with energized parts, or have apparently drowned, or asphyxiated from gas fumes. The committee is convinced that continual training in this method is absolutely essential and that, to be most effective, such training should be given before students leave the universities. Letters were therefore sent to 120 professors of electrical engineering of the various universities and colleges, together with a booklet describing the Schafer prone pressure method of resuscitation. The replies were immediate and evidenced a highly co-operative spirit. Correspondence is continuing with such universities.

Letters were also sent by the committee to the counselors of AIEE Student Branches of the universities, requesting that during the year each Student Branch arrange to have presented before the Branch a paper dealing with some phase of the problem of prevention of accidents or remedial measures after electrical shock. This had been discussed with the chairman of the committee on Student Branches and received his whole-hearted endorsement. Assistance was offered if necessary, to secure a local speaker to prepare and present such a paper. Again the reaction was spontaneous, and steps have been initiated to attain this during this or the coming year, where this subject had not already been included in the meetings.

A similar letter was authorized to be sent to the various Sections of the Institute, recommending that during each year a paper be presented before each Section dealing with the prevention of accidents or remedial measures after electrical shock. It was found that, in general, arrangements were being made by the Sections to include this important subject in their programs.

There exists a great need for the distribution of a comprehensive booklet on resuscitation of convenient size, which people could readily obtain for reference.

A movement has been started to obtain information relating to safety practices from all related foreign institutes of various kinds. Abstracts are being prepared of replies received, and it is hoped that a comprehensive summary of practices will shortly be available.

The committee was successful early in the year in arranging for the preparation of a paper for the general meeting. The paper now under preparation is concerned with safe practices in college laboratories, dealing largely with methods to assure safety to the laboratory students and personnel.

During the year a number of subjects relating to electrical safety were presented for discussion. It was found that such subjects being given active consideration were concerned with the developments in, or revision of, electrical codes or standards in general sponsored under the auspices of the American Standards Association. Some of the subjects, from a purely technical viewpoint, are being given further consideration.

Reports of Two Conferences Held During AIEE Winter Convention

As REPORTED elsewhere in this issue, five technical conferences were included on the program of the AIEE 1939 winter convention held recently in New York, N. Y.; these were on the following subjects: sound; electronics; definitions; network analysis and synthesis; and teaching of communication engineering and electronics. Brief reports of the conferences on definitions and network analysis and synthesis have been made available by the respective conference chairmen.

Conference on Definitions

By Michel G. Malti, Chairman

The third of a series of technical conferences on definitions was held during the winter convention on Tuesday, January 24, at 2:00 p.m. Prepared discussions were presented by A. Boyajian (A'18, F'26) of the General Electric Company, H. L. Hazen (A'26) of the Massachusetts Institute of Technology, W. A. Lewis, Jr. (A'27) of the Westinghouse Electric and Manufacturing Company (now of Cornell University), S. A. Schelkunoff (M'34) of the Bell Telephone Laboratories, B. R. Teare (A'29, M'36) of Yale University, and J. D. Tebo (A'36, M'36) of the Bell Telephone Laboratories.

After each written discussion the meeting was open for general comments which came from many of those present revealing enthusiasm that is hard to surpass. The object of this series of conferences is to supply subcommittee 1 of committee 42, operating under the procedure of the American Standards Association, with a set of suggestions which will help it in drafting improved definitions of fundamental terms. Definitions of engineering terms are important. Correct and consistent definitions are of more than scientific and academic interest. The membership is therefore invited to participate actively in these conferences.

Network Analysis and Synthesis

By Edward L. Bowles, Chairman

A fourth annual informal conference on network analysis and synthesis was held during the winter convention on the following subjects:

The Application of the Tensor Concept to the Complete Analysis of Lumped Active Networks, with applications of the solution to single and multiple video-amplifier stages. Presentation by D. W. Epstein and H. L. Donley, RCA Manufacturing Company.

An Experimental Network With Severe Phase Requirements. Presentation by E. B. Payne (A'20), Bell Telephone Laboratories.

A Discussion of the Independent Variables Characterizing Network Behavior and the Alternative Sets of Variables Which May Be Used. Presentation by E. A. Guillemin (A'24), Massachusetts Institute of Technology.

The interest of those attending, as evidenced both by informal expression of opinion and by lively pointed discussion and informal exchanges of ideas, is an ample testimonial to the service these meetings are effecting.

In the chairman's opinion the potentialities of informal technical conferences of this nature have not yet been fully realized. It is his sincere hope that these meetings where men may meet as man to man informally to exchange ideas without the inhibitions of formality and recorded publication will be continued.

Edison and Fritz Medals Presented During Winter Convention

FORMAL presentation of the 1938 Edison Medal of the AIEE and of the 1939 John Fritz Medal transpired at a special session of the recent AIEE winter convention held Wednesday evening, January 25, 1939. The Edison Medal, highest award of the AIEE, was presented to Doctor Dugald C. Jackson, a past president of the Institute, "for outstanding and inspiring leadership in engineering education and in the field of generation and distribution of electric power." The John Fritz Medal, highest American engineering honor, was presented to Doctor Frank B. Jewett, also a past president of the Institute, "for vision and leadership in science, and for notable achievement in the furtherance of industrial research and development in communication." President John C. Parker presided over the Edison Medal ceremonies, and Past President W. H. Harrison, vice-chairman of the John Fritz Medal board of award, presided over the Fritz Medal ceremonies.

History of Edison Medal Sketched by National Secretary Henline

President Parker first introduced National Secretary H. H. Henline who briefly outlined the history of the Edison Medal as follows: "About 35 years ago the Edison Medal Association was formed by associates and friends of Thomas A. Edison, who desired to develop a suitable method for recounting and celebrating the achievements of a quarter of a century in the art of electric lighting, with which Mr. Edison had been prominently identified.

"The Association reached a decision that the most effective means of accomplishing its objective was by the establishment of a gold medal which could serve as an honorable incentive to scientists, engineers, and artisans to maintain by their work the high standards of accomplishment which had been set by Mr. Edison.

"The American Institute of Electrical Engineers accepted an invitation to undertake the responsibility of making the awards. The Edison Medal committee, which is charged with this responsibility, is composed of 24 members. Three are appointed each year by the president for a term of five years each; three are elected each year by the board of directors from its own membership for a term of two years. The president, the national treasurer, and the national secretary are ex-officio members of the committee.

"The bylaws of the committee provide for making an annual award of the medal, and the deed of gift states that it shall be made to someone resident in the United States or Canada, for meritorious achievement in electrical science, electrical engineering, or the electrical arts.

"The medal, which was designed by James Earle Fraser, carries on its obverse a portrait of Thomas A. Edison, and on its reverse

The Roster of John Fritz Medalists

1905 **Lord Kelvin** (HM'92). For his work in cable telegraphy and other scientific achievements.

1906 **George Westinghouse** (A'02). For the invention and development of the air brake.

1907 **Alexander Graham Bell** (A'84, M'84, past president). For the invention and introduction of the telephone.

1908 **Thomas Alva Edison** (A'84, M'84, HM'28). For the invention of the duplex and quadruplex telegraph, the phonograph, the development of a commercially practical incandescent lamp, the development of a complete system of electric lighting, including dynamos, regulating devices, underground system, protective devices, and meters.

1909 **Charles T. Porter.** For his work in advancing the knowledge of steam engineering and in improvements in engine construction.

1910 **Alfred Noble.** For notable achievements as a civil engineer.

1911 **Sir William H. White.** For notable achievements in naval architecture.

1912 **Robert W. Hunt.** For his contributions to the early development of the Bessemer process.

1913 No award.

1914 **John E. Sweet.** For his achievements in machine design and pioneer work in applying sound engineering principles to the construction and development of the high-speed steam engine.

1915 **James Douglas.** For notable achievement in mining, metallurgy, education, and industrial welfare.

1916 **Elihu Thomson** (A'84, M'91, F'13, HM'28, past president). For achievement in electrical invention, in electrical engineering and industrial development, and in scientific research.

1917 **Henry M. Howe.** For his investigations in metallurgy, especially in the metallography of iron and steel.

1918 **J. Waldo Smith.** For achievement as engineer in providing the City of New York with a supply of water.

1919 **George W. Goethals.** For achievement as builder of the Panama Canal.

1920 **Orville Wright.** For achievement in the development of the airplane.

1921 **Sir Robert A. Hadfield.** For the invention of manganese steel.

1922 **Charles Prosper Eugene Schneider.** For achievement in metallurgy of iron and steel, for the development of modern ordnance, and for notable patriotic contribution to the winning of the great war.

1923 **Guglielmo Marconi** (HM'17). For the invention of wireless telegraphy.

1924 **Ambrose Swasey** (HM'28). For achievement as a designer and manufacturer of instruments and machines of precision, a builder of great telescopes, a benefactor of education, and the founder of Engineering Foundation.

1925 **John Frank Stevens.** For great achievements as a civil engineer, particularly in planning and organizing for the construction of the Panama Canal; as a builder of railroads, and as administrator of the Chinese Eastern and Siberian Railways.

1926 **Edward Dean Adams** (A'10). For great achievements as engineer, financier, scientist, whose vision, courage, and industry made possible the birth at Niagara Falls of hydroelectric power.

1927 **Elmer Ambrose Sperry** (A'84, M'93). For the development of the gyro-compass and the application of the gyroscope to the stabilization of ships and airplanes.

1928 **John Joseph Carty** (A'90, M'03, F'13, HM'29, past president). For pioneer achievement in telephone engineering and in the development of scientific research in the telephone art.

1929 **Herbert Hoover** (HM'29). As engineer, scholar, organizer of relief to war-stricken peoples, public servant.

1930 **Ralph Modjeski.** For notable achievement as an engineer of great bridges combining the principles of strength and beauty.

1931 **David Watson Taylor.** For outstanding achievement in marine architecture, for revolutionary results of persistent research in hull design, for improvement in many types of warships and for distinguished service as chief constructor of the United States Navy during the World War.

1932 **Michael Idvorsky Pupin** (A'90, F'15, HM'28, past president). Scientist, engineer, author, inventor of the tuning of oscillating circuits and the loading of telephone circuits by inductance coils.

1933 **Daniel Cowan Jackling.** For notable industrial achievement in initiating mass production of copper from low-grade ores, through application of engineering principles.

1934 **John Ripley Freeman.** Engineer—preeminent in the fields of hydraulics and water supply, fire insurance economics, and analysis of earthquake effects.

1935 **Frank Julian Sprague** (A'87, M'97, F'12, HM'32, past president). For distinguished service as inventor and engineer through the application and control of electric power in transportation systems.

1936 **William Frederick Durand.** As authority in hydrodynamic and aerodynamic science and in its practical application; outstanding leader in research and in engineering education.

1937 **Arthur Newell Talbot.** Moulder of men, eminent consultant on engineering projects, leader of research, and outstanding educator in civil engineering.

1938 **Paul Dyer Merica.** For important contributions to the development of alloys for industrial purposes.

1939 **Frank Baldwin Jewett** (A'03, M'10, F'12, past president). For vision and leadership in science, and for notable achievement in the furtherance of industrial research and development in communication.

Future AIEE Meetings

South West District Meeting
Houston, Texas, April 17–19, 1939

North Eastern District Meeting
Springfield, Mass., May 3–5, 1939

Summer and Pacific Coast Convention (combined)
San Francisco, Calif., June 26–30, 1939

Great Lakes District Meeting
Minneapolis, Minn., September 27–29, 1939

Middle Eastern District Meeting
Scranton, Pa., October 11–13, 1939

Winter Convention
New York, N.Y., January 22–26, 1940

an allegorical conception of the genius of electricity, crowned by fame."

JACKSON QUALIFICATIONS EPITOMIZED BY J. W. BARKER

Following Mr. Henline's remarks, President Parker introduced J. W. Barker, dean of engineering of Columbia University, New York, N. Y., one of the many prominent men who had obtained his engineering training under Doctor Jackson. Dean Barker referred to "a more formal Edison Medal address" that he had prepared for publication in ELECTRICAL ENGINEERING (full text appeared in the February issue, pages 64–6). He then proceeded to relate various anecdotes to show "something of what those men who have lived and worked with the Medalist. . . feel has come into their lives from him," tying these into the outline of the more formal published presentation.

Speaking of the closeness of contact between Doctor Jackson and his students, Dean Barker cited the series of teas for students at the Jackson home, initiated during the early part of the Medalist's educational career and continued throughout. He called particular attention to Doctor Jackson's educational philosophies, one of the most important of which is that the students "should be thrown into contact with the unknown as early as possible and gotten away from the cut-and-dried presentations of the textbook."

DOCTOR JACKSON'S RESPONSE

At the conclusion of Dean Barker's address, President Parker presented the medal and certificate to Doctor Jackson. Expressing his deep appreciation of the honor, Doctor Jackson called attention to the fact that never before has an Edison Medal citation coupled engineering education with engineering practice. "Indeed the phrase engineering education," he continued, "never before has been used in such a citation. The use here seems to me significant of the present relation in the field of electrical engineering, where education and practice are now recognized as complementary parts of one whole; and it turns me to the theme of engineering education, to the exclusion (at this time) of directly discussing the science and art of electric-power practice which is the conjoined part of this citation."

The major part of Doctor Jackson's address was devoted to a discussion of some of the early history of electrical-engineering education, in which field he pioneered, relating some of his experiences as the first head of the electrical-engineering department at the University of Wisconsin and his later experiences at the Massachusetts Institute of Technology. The essential substance of his address is scheduled for publication in an early issue.

HISTORY OF FRITZ MEDAL OUTLINED BY W. H. HARRISON

Immediately following the Edison Medal ceremonies, President Parker turned the meeting over to Past-President W. H. Harrison, vice-chairman of the John Fritz Medal board of award, who spoke as follows on the history of the medal:

"The name of John Fritz is so familiar to all engineers that I need make only passing mention of the deeds that make him still live to those of us in the profession. His name and achievements are a legend wherever iron and steel men relive the early days in the development of that great industry in the Lehigh Valley.

"Striking as were his achievements as an engineer, impressive as was his influence in molding the foundations of our industrial world, his greatness as a man overshadows these accomplishments. As a matter of fact it is as a man and as a unique per-

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The Roster of Edison Medalists

1909 **Elihu Thomson** (A'84, M'91, F'13, HM'28, past president). For meritorious achievement in electrical science, engineering, and arts, as exemplified in his contributions thereto during the past 30 years.

1910 **Frank J. Sprague** (A'24, M'97, F'12, HM'32, past president). For meritorious achievement in electrical science, engineering, and arts, as exemplified in his contributions thereto.

1911 **George Westinghouse** (A'02). For meritorious achievement in connection with the development of the alternating-current system for light and power.

1912 **William Stanley** (A'87, M'98, F'13). For meritorious achievement in invention and development of alternating-current systems and apparatus.

1913 **Charles F. Brush** (A'84, M'84, HM'29). For meritorious achievement in the invention and development of the series arc lighting system.

1914 **Alexander Graham Bell** (A'84, M'84, past president). For meritorious achievement in the invention of the telephone.

1916 **Nikola Tesla** (A'88, F'17). For meritorious achievement in his early original work in polyphase and high-frequency electrical currents.

1917 **John J. Carty** (A'90, M'03, F'13, HM'29, past president). For his work in the science and art of telephone engineering.

1918 **Benjamin G. Lamme** (A'03, M'03). For invention and development of electrical machinery.

1919 **W. L. R. Emmet** (A'93, M'94, HM'33). For inventions and developments of electrical apparatus and prime movers.

1920 **Michael I. Pupin** (A'90, F'15, HM'28, past president). For his work in mathematical physics and its application to the electrical transmission of intelligence.

1921 **Cummings C. Chesney** (A'94, M'99, F'13, HM'38, past president). For early developments in alternating-current transmission.

1922 **Robert Andrews Millikan** (M'22, HM'33). For his experimental work in electrical science.

1923 **John W. Lieb** (A'87, M'92, F'13, past president). For the development and operation of electric central stations for illumination and power.

1924 **John W. Howell** (A'87, M'88, F'12). For his contributions toward the development of the incandescent lamp.

1925 **Harris J. Ryan** (A'87, M'95, F'23, past president). For his contributions to the science and the art of high-tension transmission of power.

1927 **William D. Coolidge** (A'10, M'34). For his contributions to the incandescent electric-lighting and the X-ray arts.

1928 **Frank B. Jewett** (A'03, M'10, F'12, past president). For his contributions to the art of electrical communication.

1929 **Charles F. Scott** (A'92, M'93, F'25, HM'29, past president). For his contributions to the science and art of polyphase transmission of electrical energy.

1930 **Frank Conrad** (M'23). For his contributions to radio broadcasting and short-wave radio transmission.

1931 **E. W. Rice, Jr.** (A'87, M'88, F'13, HM'33, past president). For his contributions to the development of electrical systems and apparatus and his encouragement of scientific research in industry.

1932 **Bancroft Gherardi** (A'95, M'04, F'12, past president). For his contributions to the art of telephone engineering and the development of electrical communication.

1933 **Arthur E. Kennelly** (A'88, M'99, F'13, HM'33, past president). For meritorious achievements in electrical science, electrical engineering, and the electrical arts as exemplified by his contributions to the theory of electrical transmission and to the development of international electrical standards.

1934 **Willis R. Whitney** (A'01). For his contributions to electrical science, his pioneer inventions, and his inspiring leadership in research.

1935 **Lewis B. Stillwell** (A'92, M'92, F'12, past president). For distinguished achievements and his pioneer work in the generation, distribution, and utilization of electric energy.

1936 **Alex Dow** (A'93, M'95, F'13, HM'37). For outstanding leadership in the development of the central station industry and its service to the public.

1937 **Gano Dunn** (A'91, M'94, F'12, past president). For distinguished contributions in extending the science and art of electrical engineering, in the administration of great engineering works, and for inspiring leadership in the profession.

1938 **Dugald C. Jackson** (A'87, M'90, F'12, past president). For outstanding and inspiring leadership in engineering education and in the field of generation and distribution of electric power.

sonality that he gives us our greatest inspiration.

"In these perplexing times his life's work is refreshing, for it reads like the history of America itself. There are two passages which I should like to quote from a biographical sketch written in the early part of this century:

> John Fritz was born August 21, 1822, in Londonderry, Chester County, Pa. His grandfather, Johannes Fritzius, of Hesse Cassel, settled in Pennsylvania in 1802. His father, George Fritz, married the daughter of a Scotch-Irish immigrant. They had seven children—four girls and three boys—of whom John was the first.
>
> His father, a millwright and mechanic, repeatedly followed the call of the trade which he loved better than farming; and the three sons, inheriting his talent and his predilection, after dutifully following the plough in their youth, abandoned it for the pursuit of mechanical engineering, in which, educating themselves without the aid of technical instruction, they all achieved high position.

"Thus he started his life with the most modest background. As to his work, continuing the quotation:

> During nearly 30 years of work with Bethlehem Iron Company, Mr. Fritz, supported by the faith and courage which he inspired in other men, made that enterprise one of the most famous in the world. The introduction of open-hearth furnaces and of the Thomas basic process; the progressive improvements of strength, simplicity, and automatic handling in the rolling-mills; the adoption of the Whitworth forging-press; the manufacture of armorplate; the erection of a 125-ton steam hammer; and innumerable other improvements in the manufacture of iron and steel, owe their present perfection in a large degree to his inventive genius, practical resourcefulness, and patient study.
>
> The stamp of his mind may be found on almost every detail of construction and operation throughout a wide range of processes and products.

"It was that background that impelled his associates and friends to establish the John Fritz Medal 37 years ago, and it is that same background that moves us to revere his memory tonight.

"As to the medal, the idea was conceived in connection with the planning of the celebration of his 80th birthday on August 21, 1902, and the first award was appropriately made to him at that time.

"The Rules of Award provide that: 'The medal shall be awarded for notable scientific or industrial achievement.' 'There shall be no restriction on account of nationality or sex,' and that 'awards shall be made (annually) by a board of 16, appointed or chosen in equal numbers from the membership of the four national engineering societies: civil, mining, mechanical, and electrical.'

"The roster of John Fritz Medalists contains the names of 34 of the world's most illustrious engineers and scientists, among whom are those immortals in our own field of electricity: Kelvin, Bell, Edison, Elihu Thomson, Westinghouse, Marconi, and Pupin. Mention of these names gives more eloquent expression to the deep significance of this award than anything further I can say."

High Lights of Jewett Career Presented by Doctor Compton

Doctor Harrison concluded his remarks by introducing Doctor Karl T. Compton (F'31) president of the Massachusetts Institute of Technology, Cambridge, who outlined the principal achievements of Medalist Jewett. Full text of Doctor Compton's address appears elsewhere in this issue.

Doctor Jewett's Response

At the conclusion of Doctor Compton's address, Doctor Harrison presented the medal and certificate to Doctor Jewett who, in accepting the medal, said "I find myself in a whirlpool of conflicting emotions."

"On the one hand," Doctor Jewett continued, "is a sense of humility which verges on a fear that I am an impostor accepting for myself something, the major part of which belongs to others—my associates, present and past. This is not a new feeling nor is this public confession of it the first I have made. I have been the recipient of many honors, and at other times and in other places when they have come to me I have acknowledged my debt to my associates. The feeling was never stronger than it is on this occasion because the honor is the greatest I have ever received from my fellow scientists and engineers.

"In the mood of this feeling of humility I can only say that no one knows better than I do the degree to which success in modern engineering is the result of cooperative effort and one in which the dice of individual credit are frequently loaded somewhat by chance. If it were physically possible and could be done without offense to those who have made the award, I think I would cut this medal up into many parts, each one a tiny replica of the original and distribute them to a host of associates, each separate replica wrapped up in a particular personal expression of my appreciation for assistance given.

"Naturally most of them would go to members of the Bell System family, but there would be an amazing number outside and some of them would appear in surprising places. . . . The biggest replica, however, one cut from the very center of the Medal, would be a birthday present to the other partner in the family firm—my wife—without whose love, support, and wise advice, I would have fallen short in many things.

"And now for a look at the other side of the vortex of my emotions. Here I find nothing but elation. Not just the elation of receiving a new and valuable bauble or the plaudits of the crowd but the elation which comes only from knowing that you have been judged by your clan and approved Every one likes to receive tokens of esteem and plaudits even when one knows that the crowd is fickle and may be showering anathema the next instant. There is another sort of commendation however. It is the kind the ancient philosopher had in mind when centuries ago he made the wise observation, the exact words of which I am sorry to say I have forgotten, to the effect that the only worth-while judgments are those of men who are themselves worthy of favorable judgment. When, therefore, the tribes of the clan through representatives whom they consider worthy pass judgment on a clansman, it justifies elation of a different and more substantial sort."

In the remaining major part of his address, Doctor Jewett presented "a few fragments of his history and philosophy." The essential substance of this portion of his address is scheduled for publication in an early issue.

Nominating Committee Announces Candidates

A complete official ticket of candidates for the Institute offices that will become vacant August 1, 1939, was selected by the national nominating committee at its meeting held at Institute headquarters, New York, N. Y., January 23, 1939. This committee, in accordance with the constitution and bylaws, consists of 15 members, one selected by the executive committee of each of the ten geographical Districts, and five selected by the board of directors from its own membership.

The following members of the committee were present: C. A. Andrews, San Francisco, Calif.; C. R. Beardsley, New York, N. Y.; F. M. Farmer (for a part of the meeting), New York, N. Y.; E. S. Fields, Cincinnati, Ohio; O. C. Haycock, Salt Lake City, Utah; T. G. LeClair, Chicago, Ill.; A. H. Lovell, Ann Arbor, Mich.; F. R. Maxwell, Jr., University, Ala.; L. N. McClellan, Denver, Colo.; M. J. McHenry, Toronto, Ont.; C. A. Powel, East Pittsburgh, Pa.; A. L. Powell, New York, N. Y.; R. W. Sorensen, Pasadena, Calif.; A. C. Stevens, Schenectady, N. Y.; J. B. Thomas, Fort Worth, Tex.; A. M. MacCutcheon (alternate), Cleveland, Ohio; and H. H. Henline, New York, N. Y., secretary of the committee.

The following is the list of official candidates selected by the committee:

For President

F. Malcolm Farmer, vice-president and chief engineer, Electrical Testing Laboratories, New York, N. Y.

For Vice-Presidents

C. T. Sinclair, electrical engineer, transmission and distribution, Duquesne Light Company, Pittsburgh, Pa. (Middle Eastern District, number 2).

E. E. George, superintendent of system operation, Tennessee Electric Power Company, Chattanooga (Southern District, number 4).

Albert L. Turner, chief engineer, Northwestern Bell Telephone Company, Omaha, Neb. (North Central District, number 6).

H. W. Hitchcock, chief engineer, Southern California Telephone Company, Los Angeles (Pacific District, number 8).

J. M. Thomson, chief designing engineer, Ferranti Electric, Ltd., Toronto, Ont., Canada (Canadian District, number 10).

For Directors

Mark Eldredge, chief engineer, Memphis Power and Light Company, Memphis, Tenn.

R. E. Hellmund, chief engineer, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

Frank J. Meyer, vice-president in charge of operation, Oklahoma Gas and Electric Company, Oklahoma City.

For National Treasurer

W. I. Slichter, professor of electrical engineering and head of department, Columbia University, New York, N. Y.

The constitution and bylaws of the Institute provide that the nominations made by the national nominating committee shall be published in the March issue of ELECTRICAL ENGINEERING. Provision is made for independent nominations as indicated in the following excerpts from the constitution and bylaws:

Constitution

Sec. 31. Independent nominations may be made by a petition of twenty-five (25) or more members sent to the National Secretary when and as provided in the By-laws; such petitions for the nomination of

Vice-Presidents shall be signed only by members within the District concerned.

By-laws

Sec. 23. Petitions proposing the names of candidates as independent nominations for the various offices to be filled at the ensuing election, in accordance with Article VI, Section 31 (Constitution), must be received by the secretary of the National Nominating Committee not later than March twenty-fifth of each year, to be placed before that committee for the inclusion in the ballot of such candidates as are eligible.

On the ballot prepared by the National Nominating Committee in accordance with Article VI of the Constitution and sent by the National Secretary to all qualified voters during the first week in April of each year, the names of the candidates shall be grouped alphabetically under the name of the office for which each is a candidate.

(Signed) National Nominating Committee
by H. H. Henline, *Secretary*

Biographical Sketches of Nominees

In order that those not personally acquainted with the nominees may know something of them and their qualifications for the Institute offices for which they have been nominated, brief biographical sketches are given in the "Personals" columns of this issue.

South West District Meeting in Houston, April 17–19

THE AIEE South West District meeting will be held in Houston, Tex., April 17–19, 1939. Headquarters for the meeting will be in the Rice Hotel. The program is complete with technical sessions on varied subjects of particular interest to the Southwest, three student sessions, and attractive entertainment features.

Houston offers unusual opportunities to visitors interested in engineering and industry. It is 50 miles inland from the Gulf of Mexico, yet is the nation's third largest seaport. On both sides of the ship channel are many industries and vast oil refineries. Nearby is the San Jacinto Battleground. Fifty miles to the south are the beaches of the Gulf of Mexico at the island city of Galveston with its new causeway connecting it to the mainland. Houston is virtually surrounded by oil and gas wells which may be seen in any degree of completion from any of the highways entering the city. One thousand oil companies have offices in Houston. Within 50 miles are the Gulf Coast sulphur mines where most of the world's supply of natural sulphur is obtained.

Principal Hotels in Houston and Rates

Hotel	Single Room With Bath	Double With Bath: Double Bed	Double With Bath: Twin Beds
Rice*	$2.50 to $6.00	$4.00 to $7.00	$6.00 to $8.00
Ben Milam	2.50 to 5.00	3.50 to 4.00	4.50 to 5.00
Lamar	2.00 to 6.00	4.00 to 6.00	5.00 to 8.00
Sam Houston	2.00 to 3.00	3.00 to 4.00	4.00 to 5.00
Texas State	3 00 to 5.00	4.50 to 5.00	5.00 to 8.00
William Penn	2.00 to 3.00	3.00 to 4.00	4.00 to 5.00

* Meeting headquarters.

Technical Sessions

The technical program presents a variety of papers on such subjects as electrical equipment for oil-field tool manufacturing, power plants, voltage regulators, carrier telephone systems, relays, electrical aspects of petroleum prospecting, design of capacitor-type bushings, short-circuit forces in bus structures, substations, symmetrical components, signaling, phase-angle control, and symposia on pipe line corrosion and operating experience with rural lines. Approximately a dozen papers will be presented in the various student sessions.

Inspection Trips

Three major inspection trips are scheduled. Arrangements may be made at the registration desk for trips to any industry or other place of interest not scheduled. Guides and maps will be available to assist drivers in reaching the various points on the trips.

1. *Deepwater Power-Champion Paper Trip.* These two plants are on the ship channel about 11 miles from convention headquarters. The Houston Lighting and Power Company plant is of 147,000-kw capacity and has a 1,400-pounds-pressure turbine. The Champion Paper and Fibre Company manufactures paper from slash pine. Transportation at nominal cost will be provided for those not using their own cars.

2. *Telephone Company—Underground Network—Office Building Air Conditioning Systems Trip.* This trip includes inspection of local and toll offices of Southwestern Bell Telephone Company, the underground networks of Houston Lighting and Power Company, and air-conditioning apparatus in large office buildings. It is in the business district of the city and no transportation is required.

3. *Turning Basin—San Jacinto Battleground—Radio Station Trip.* A launch will be available at the Turning Basin for a short trip on the ship channel. At San Jacinto Battleground is a magnificent new monument. Near San Jacinto are radio stations KPRC and KTRH simultaneously using a 375-foot vertical self-supporting radiator. The battleground is about 18 miles from convention headquarters. Transportation will be provided at nominal cost for those requiring it.

Entertainment and Sports

No definite program of sports is being planned. Arrangements for play at several clubs may be made with the committee. The entertainment committee has planned a real Dutch stag supper at low cost for Monday night, the 17th. Tuesday noon a joint luncheon with the Houston Engineers' Club will be held in the Rice Hotel. Tuesday at 7:30 a dinner dance will be given in the Rice Hotel ballroom.

Women's Entertainment

The following program is planned for women attending the convention:

Monday, 1:30 to 8:30 p.m. Sightseeing trip and informal supper at the Carolina Pines.

Tuesday, 10 a.m. to 2:30 p.m. Bridge luncheon at the Braeburn Country Club.

Tuesday, 7:30 p.m. Dinner dance, Rice Hotel.

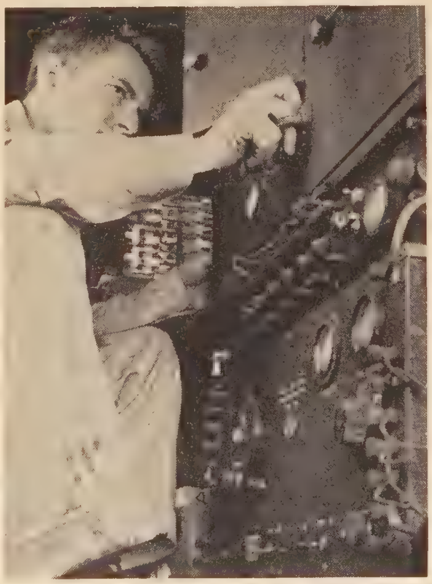
Transportation will be provided for the visiting women by women of the Houston Section. Complete details of entertainment will be available at the registration desk.

Advance Registration

Members in the nearby territory who will attend the meeting are urged to register in advance by returning the advance-registration card which they will receive by mail. This will be helpful to committees and will permit badges to be made ready in advance, thus avoiding congestion at the registration desk.

Hotel Reservation

All members planning to attend should make their own hotel reservations early by writing direct to the hotel. All the hotels listed elsewhere are within a few minutes



Texas Company photo

Seismographic prospecting is one of the various subjects to be discussed at the forthcoming AIEE South West District meeting. Measurements are recorded by oscillographs installed on motor trucks, such as the one shown above walk of the Rice, the headquarters hotel, and are largely or entirely air conditioned.

Student Branch Convention

The Branches at Rice Institute and the Agricultural and Mechanical College of Texas will act as hosts. Three student sessions have been provided and it is expected each Branch will present a paper. The Tuesday afternoon session should be of particular interest to students as the speakers will bring valuable information about the relatively new field of electricity in geophysics and petroleum prospecting. All trips and entertainment features of the convention are open to students. Additional inspection trips may be arranged. Branch counselors should contact the counselor at Rice Institute for information on trips to oil fields, sulphur mines, or other points of interest. Hotel facilities for students are available at $1.25 per person. Counselors should make reservation direct with the hotel for their student group.

Committees

Committees for the meeting are as follows:

General meeting: F. C. Bolton, L. T. Blaisdell, V. O. Clements, Seth Evans, and H. C. Dillingham.

Entertainment: H. P. Heafer, chairman.

Attendance and publicity: J. B. Arthur, chairman.

Transportation and inspection: L. K. Del Homme, chairman.

Hotels and registration: H. F. Staacke, chairman.

Finance: E. M. Wise, chairman.

Meetings and papers: N. F. Rode, chairman.

Student activities: N. F. Rode, chairman of counselors; J. S. Waters, R. P. Ward.

Tentative Program

Monday, April 17

8:00–10:00 a.m.—Registration

10:00 a.m.—General Meeting

Announcements, F. C. Bolton, vice-president, AIEE South West District.

Address of welcome, H. O. Clarke, Jr., vice-president, Houston Lighting and Power Company.

10:30 a.m.—Technical Session

Presiding: E. A. Heath, Kansas Gas and Electric Company, and C. F. Terrell, Gulf States Utilities Company.

ELECTRICITY IN AN OIL FIELD EQUIPMENT MANUFACTURING PLANT, **Seth Evans,** Hughes Tool Company.

THE MOUNTAIN CREEK PLANT, **H. K. Doyle,** Dallas Power and Light Company.

RESONANT-TYPE CONSTANT-CURRENT REGULATORS, **R. R. Miner,** Kansas Gas and Electric Company.

1:30 p.m.—Inspection Trips

6:30–8:30 p.m.—Stag supper, Gulf Brewing Company

Tuesday, April 18

9:00–10:30 a.m.—Technical Session

Presiding: H. P. Lawther, Southwestern Bell Telephone Company, and J. W. Ramsay, University of Texas.

LINE PROBLEMS RELATING TO THE TYPE J OPEN-WIRE CARRIER SYSTEM, **L. M. Ilgenfritz, R. N. Hunter,** and **A. L. Whitman,** Bell Telephone Laboratories.

SOME APPLICATIONS OF THE TYPE J CARRIER SYSTEM, **L. C. Starbird** and **J. D. Mathis,** Southwestern Bell Telephone Company.

9:00 a.m.–12:05 p.m.—Student Session

Presiding: J. M. Wilson, Rice Institute, and J. Y. Bowman, Southern Methodist University.

Papers from Student Branches of Rice Institute, University of Missouri, Missouri School of Mines and Metallurgy, University of Texas, and University of New Mexico.

10:45 a.m.–12:05 p.m.—Technical Session

Presiding: Louis P. Thein, St. Mary's University and Marvin Thrasher, Texas Power and Light Company.

CARRIER CURRENT RELAYING, **E. H. Bancker,** General Electric Company.

OUT OF STEP BLOCKING AND SELECTIVE TRIPPING WITH IMPEDANCE RELAYS, **H. R. Vaughan,** Westinghouse Electric and Manufacturing Company, and **E. C. Sawyer,** Gulf States Utilities Company.

12:15 p.m.—Luncheon meeting with Houston Engineers' Club, Rice Hotel

1:30–3:15 p.m.—Technical Session

Presiding: P. H. Robinson, Houston Lighting and Power Company, and B. F. Meador.

GEOPHYSICAL PROSPECTING, **L. W. Blau,** Humble Oil and Refining Company.

ELECTRICAL EQUIPMENT IN REFLECTION SEISMOGRAPH PROSPECTING, **C. C. Nash** and **C. C. Palmer,** Humble Oil and Refining Company.

3:30–5:15 p.m.—Technical Session

Symposium: ELECTRICITY IN PIPE LINE CORROSION. Leader: J. C. Stirling, Stanolind Pipe Line Company, Tulsa. Contributors: R. A. Brannon, Humble Pipe Line Company, Houston; V. L. Nealy, Texas Pipe Line Company, Houston; W. H. Stewart, Sun Oil Company, Beaumont; David Harrell, Jr., Houston Pipe Line Company, Houston; and Earl Lipscomb, Western Union Telegraph Company, Dallas.

7:30 p.m.—Dinner Dance

Wednesday, April 19

9:00–10:30 a.m.—Technical Session

Presiding: A. L. Jones, Jr., General Electric Company, and V. O. Clements, Westinghouse Electric and Manufacturing Company.

IMPROVEMENTS IN THE CONSTRUCTION OF CONDENSER BUSHINGS, **A. J. A. Peterson,** Westinghouse Electric and Manufacturing Company.

AN ELECTRO MECHANICAL ANALYSIS OF SHORT CIRCUIT FORCES IN SIMPLE BUS STRUCTURES, **E. W. Boehne,** General Electric Company.

A SURVEY OF CONTEMPORARY PRACTICE IN THE APPLICATION OF FACTORY-BUILT SUBSTATIONS, **Frank M. Starr,** General Electric Company.

9:00 a.m.–12:15 p.m.—Student Session

Presiding: W. C. Morris, Agricultural and Mechanical College of Texas, and A. J. McCrocklin, University of Texas.

Papers from Student Branches of Oklahoma Agricultural and Mechanical College, Kansas State College, Texas Technological College, University of Oklahoma, and Southern Methodist University.

10:45 a.m.–12:15 p.m.—Technical Session

Presiding: J. S. Porter, Westinghouse Electric and Manufacturing Company.

MUTUAL INDUCTANCE, IMPEDANCE, POWER, AND SYMMETRICAL COMPONENTS EXPRESSED IN TERMS OF MATRICES, **Myril B. Reed,** Armour Institute of Technology.

SIGNALLING OVER ZERO SEQUENCE NETWORK, **J. D. Browder,** Oklahoma Gas and Electric Company.

12:15 p.m.—Luncheon conference, counselors and Branch chairmen

1:30–3:15 p.m.—Technical Session

Presiding: L. E. Cook, Texas Power and Light Company, and H. M. Stewart, Humble Oil and Refining Company.

RECENT DEVELOPMENTS IN GENERATOR VOLTAGE REGULATION, **C. R. Hanna, K. A. Oplinger,** and **C. E. Valentine,** Westinghouse Electric and Manufacturing Company.

COMBINED VOLTAGE AND PHASE ANGLE CONTROL UNDER LOAD, **H. L. Reynolds,** Allis-Chalmers Manufacturing Company.

1:30–4:30 p.m.—Student Session

Presiding: John Burt, Texas Technological College, and J. Jacobson, University of New Mexico.

Papers from Student Branches of University of Arkansas, University of Kansas, Washington University, and Agricultural and Mechanical College of Texas.

3:45–5:00 p.m.—Technical Session

Symposium: OPERATING EXPERIENCES OF UTILITIES WITH RURAL LINES. Leader: Bryce Brady, Oklahoma Gas and Electric Company, Enid. Contributors: P. H. Underwood, Houston Lighting and Power Company, Houston; G. W. Bean, Texas Electric Service Company, Fort Worth; N. B. Gussett, San Antonio Public Service Company, San Antonio; R. R. Miner, Kansas Gas and Electric Company, Wichita; C. M. Lytle, Kansas City Power and Light Company, Kansas City; L. E. Cook, Texas Power and Light Company, Dallas; and E. B. Jennings, Southwestern Bell Telephone Company, Dallas.

Plans Near Completion for North Eastern District Meeting

Plans for the AIEE North Eastern District meeting to be held at the Hotel Kimball, Springfield, Mass., May 3–5, 1939, are now approaching the final stages.

Four technical sessions, one general session, and one or two student sessions will be scheduled. Technical sessions are to be on industrial power application, power generation, power transmission and distribution, and selected subjects. The session on power generation will feature a symposium on hydrogen-cooled turbogenerators. The general session will present a guest speaker of national prominence, who will speak on phases of economics which are of national importance and interest. The program for the student session is to be arranged by E. M. Strong of Cornell University.

Inspection Trips

Inspection trips of varied interest have been arranged to several of the diverse industrial plants of Springfield and nearby cities during the meeting period. Included are:

Bigelow Sanford Carpet Company, Thompsonville Conn.

Stevens Paper Company, Westfield, Mass.
Morart Rotophoto Company, Holyoke, Mass.
Fisk Rubber Company, Chicopee, Mass.
Chapman Valve Manufacturing Company, Indian Orchard, Mass.
Westinghouse Electric and Manufacturing Company, East Springfield, Mass.
Package Machinery Company, Springfield, Mass.
Springfield Armory, Springfield, Mass.

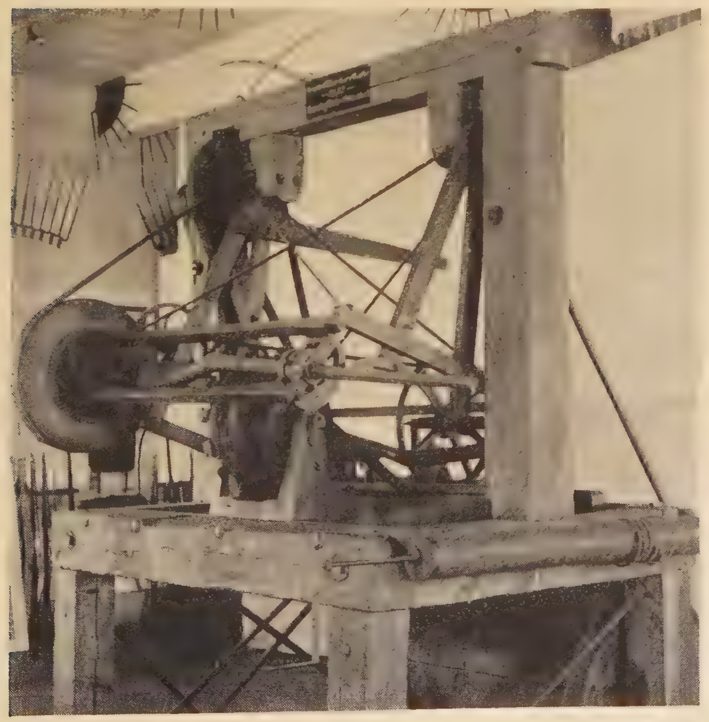
A trip after the meeting is being arranged for Saturday morning, May 6, to the Pratt and Whitney Aircraft Corporation, Hartford, Conn.

Members desiring to attend the inspection trip to either the Pratt and Whitney Aircraft Corporation or the Springfield Armory, may be required to submit proof of citizenship. Ladies will not be admitted at either of these two places. The trip to the Springfield Armory is expected to be very popular.

Originally established by the Massachusetts Bay Colony as a supply depot during the Revolutionary War, the present site of the Springfield Armory was visited and selected by George Washington for a federal armory in 1789. Congress passed an act establishing it as such in 1794. The first Springfield musket was produced in 1795. Since that time the Springfield Armory has done practically all the development and normally a very large part of the production of the shoulder arms of the armed forces of the United States, and for years the Springfield rifle has had the reputation of being the finest small arm of its class in the world.

The armory has an interesting museum of war relics and small arms of all descriptions from many countries, ancient and modern. This complete collection covers the evolution of the shoulder arm from the ancient Chinese hand cannon to the modern Garand rifle, the latest development of the Springfield Armory. At the museum the Blanchard lathe, built in 1822, may be seen. Although originally designed for turning gun stocks, which it did at the rate of two per hour, it had a great influence on the boot and shoe industry in New England.

Arrangements have been made for the entertainment of members and their guests, but details have not yet been released by the committee.



Blanchard lathe, constructed in 1822 for turning gun stocks, at Springfield Armory

AIEE Section Organized at San Diego

The AIEE San Diego Section, authorized by the AIEE board of directors in December 1938, held its organization meeting in San Diego, Calif., January 18, 1939. Seventeen members and two guests attended this first meeting of the Institute's 66th Section, whose territory consists of San Diego and Imperial counties.

Officers were elected to take office immediately and serve until August 1, 1939. They are: F. F. Evenson (A'21, M'29) consulting engineer, San Diego, *chairman;* W. L. Bryant (A'28, M'37) electrical engineer, Imperial Irrigation District, Imperial, *vice-chairman;* C. J. Nevitt (A'33) electrical estimator, San Diego Consolidated Gas and Electric Company, San Diego, *secretary-treasurer;* and H. A. Campbell (A'35) electrical engineer, Consolidated Aircraft Corporation, San Diego, R. P. Thompson (A'25) engineer, Southern California Telephone Company, San Diego, D. W. Proebstel (A'18, M'21) electrical engineer, Imperial Irrigation District, Imperial, and E. E. Eiler (M'24) La Jolla, *executive committee.* L. M. Klauber (A'11, F'23) vice-president in charge of operation, San Diego Consolidated Gas and Electric Company, presided at the meeting.

AIEE Directors Meet During Winter Convention

THE regular meeting of the board of directors of the American Institute of Electrical Engineers was held at Institute headquarters, New York, N. Y., on January 24, 1939.

Present were: *President*—John C. Parker, New York, N. Y. *Past Presidents*—W. H. Harrison, New York, N. Y.; A. M. MacCutcheon, Cleveland, Ohio. *Vice-Presidents*—F. C. Bolton, College Station, Tex.; C. L. Dawes, Cambridge, Mass.; F. M. Farmer, New York, N. Y.; A. H. Lovell, Ann Arbor, Mich.; L. N. McClellan, Denver, Colo.; M. J. McHenry, Toronto, Ont.; I. Melville Stein, Philadelphia, Pa.; and Edwin D. Wood, Louisville, Ky. *Directors*—C. R. Beardsley, C. R. Jones, H. S. Osborne, New York, N. Y.; F. Ellis Johnson, Madison, Wis.; W. B. Kouwenhoven, Baltimore, Md.; F. H. Lane, L. R. Mapes, Chicago, Ill.; K. B. McEachron, Pittsfield, Mass.; C. A. Powel, East Pittsburgh, Pa.; D. C. Prince, Philadelphia, Pa.; and R. W. Sorensen, Pasadena, Calif. *National Treasurer*—W. I. Slichter, New York, N. Y. *National Secretary*—H. H. Henline, New York, N. Y. Present by invitation for a part of the meeting were Doctors William McClellan, president, and F. M. Feiker, executive secretary of American Engineering Council, Washington, D. C.

Regrets were presented from Director Vannevar Bush, of Washington, D. C., absent on account of illness, and Vice-President J. P. Jollyman of the Pacific District.

Minutes were approved of meetings of the board of directors on October 25, 1938, and the executive committee on December 16, 1938.

Disbursements for January, amounting to $23,776.04, were reported by Chairman Jones of the finance committee and approved by the board.

As the Institute's budget which was adopted last October included an appropriation for American Engineering Council for only the period of six months beginning October 1, 1938, consideration was given to the question of a further contribution; and the board voted an additional appropriation of $3,000 for the current budget year, ending September 30, 1939, without any commitment as to future contributions.

A report was presented and approved of a meeting of the board of examiners held January 19, 1939. Upon the recommendation of the board of examiners, the following actions were taken: 2 applicants were transferred to the grade of Fellow; 8 applicants were transferred and 11 were elected to the grade of Member; 90 were elected to the grade of Associate; 144 Students were enrolled.

A resolution was adopted "that the 1939 annual meeting of the American Institute

Future Meetings of Other Societies

American Chemical Society. Annual spring meeting, April 3–7, 1939, Baltimore, Md.

American Electrochemical Society. Spring convention, April 26–29, 1939, Columbus, Ohio.

American Institute of Chemical Engineers. 31st semiannual meeting, May 15–17, 1939, Akron, Ohio.

American Institute of Mining and Metallurgical Engineers. 22d national open hearth convention, April 26–28, 1939, Cleveland, Ohio.

American Physical Society. 227th meeting, April 27–29, 1939, Washington, D. C.

American Railway Engineering Association. Annual convention, March 14–16, 1939, Chicago, Ill.

American Society for Testing Materials. 42d annual meeting, June 26–30, 1939, Atlantic City, N. J.

American Society of Civil Engineers. Spring meeting, April 19–22, 1939, Chattanooga, Tenn.

American Society of Mechanical Engineers. Semiannual meeting, July 10–14, 1939, San Francisco, Calif.

American Society of Refrigerating Engineers. Spring meeting, May 21–22, 1939, Hershey, Pa.

Association of Iron and Steel Engineers. Annual spring conference, March 27–28, 1939, Birmingham, Ala.

Edison Electric Institute. Annual sales conference, March 20–24, 1939, Chicago, Ill. Technical committees meeting, May 1–4, 1939, Chicago, Ill.

Institute of Radio Engineers. Joint meeting with American section of the International Scientific Radio Union, April 28–29, 1939, Washington, D. C.

National Electrical Manufacturers Association. May 14–18, 1939, Hot Springs, Va.

National Fire Protection Association. Annual meeting, May 8–12, 1939, Chicago, Ill.

Society for the Promotion of Engineering Education. 47th annual meeting, June 19–23, 1939, State College, Pa.

Society of Automotive Engineers. SAE world automotive engineering congress, May 22, 1939.

of Electrical Engineers be held in San Francisco, California, on Monday, June 26." A schedule of national conventions and District meetings, recommended by the committee on planning and co-ordination, was adopted, as follows: winter convention, New York, January 22–26, 1940; summer convention, Swampscott, Mass., June 24–28, 1940; Pacific Coast convention, Vancouver, B. C., dates to be decided later; and a Middle Eastern District meeting, Cincinnati, Ohio, in the fall.

Section 93 of the bylaws was amended to read as follows:

> Sec. 93. The manuscript of any paper to be presented at a national meeting or convention of the Institute must be received at Institute headquarters for the consideration of the technical program committee not less than 60 days before the date of presentation. With a view to setting up a schedule for the orderly conduct of the work, the technical program committee may specify such additional periods as may be necessary. The executive committee shall have the power to waive the 60-day requirement upon request of the chairman of the technical program committee.
>
> No paper shall be announced for presentation at any national meeting or convention until after the paper has been accepted for presentation by the technical program committee.

Upon recommendation of the publication committee, based upon the results of an inquiry addressed to the membership to ascertain the demand for the book, the board authorized the publication of a 17-year cumulative index to the TRANSACTIONS, which will be sold at $2 per copy.

The board approved in principle proposed revisions of sections 45, 46, 47, and 98 of the bylaws, relating to the publication and release of papers presented at Section, Branch, and District meetings. The revisions will therefore take the usual course for formal adoption by the board of directors at a later meeting.

Upon the recommendation of the committee on research, the board voted to apply to The Engineering Foundation for continued support, during the year beginning October 1, 1939, of a research project at Johns Hopkins University on stability of impregnated paper insulation; also to accept technical sponsorship of a research project on insulating oils and cable saturants at Massachusetts Institute of Technology and to request The Engineering Foundation to accept financial sponsorship of the project.

Doctor Vannevar Bush and Doctor H. S. Osborne were reappointed representatives of the Institute on the council of the American Association for the Advancement of Science for the year 1939.

F. Malcolm Farmer was nominated for re-election by the United Engineering Trustees, Inc., as a member of The Engineering Foundation board for the four-year term beginning in October 1939.

Gano Dunn was reappointed an Institute representative on the Hoover Medal board of award for the six-year term beginning in May 1939.

The board confirmed the appointment by the president of the following delegates of the Institute to the 1939 transportation symposium under the auspices of The Franklin Institute, at Philadelphia, Pa., on February 7, 1939: C. M. Davis, J. V. B. Duer, W. S. H. Hamilton, F. B. Powers, I. Melville Stein, and Sidney Withington.

The president was empowered to appoint a delegate to attend the centennial celebration of Duke University, at Durham, N. C., April 21–23, 1939, and a delegate to the Engineering Congress to be held at Wellington, N. Z., in February 1940, during the centenary of the official founding of New Zealand.

The board expressed its sympathy for transmittal to the members of the family of Charles S. Ruffner, who died on January 21, 1939. Mr. Ruffner was a manager of the Institute 1916–20, and vice-president 1920–21.

Other subjects were discussed, reference to which may be found elsewhere in this issue or in future issues of ELECTRICAL ENGINEERING.

Honor Memory of Elihu Thomson

A meeting in commemoration of the life and work of Professor Elihu Thomson, who at the time of his death nearly two years ago was recognized as the dean of American scientists, was held in the halls of the American Philosophical Society and the Franklin Institute in Philadelphia, Pa., on February 16, 1939. Papers, each dealing with a different phase of his life, were read by nine men high in the scientific and electrical art, who were closely associated with Professor Thomson during his lifetime.

Although Professor Thomson is credited with more than 700 inventions and was one of the founders of the General Electric Company, he always shunned publicity and as a result little has been written on his life and work. No biography exists today, despite the fact he received honors greater than any other American scientist during his lifetime. The papers presented in Philadelphia form the nucleus of a biography, and in addition, several other former associates of Professor Thomson have prepared manuscripts dealing with some important phase of his life or work, which are now on file in the library of the American Philosophical Society.

Speakers at the meeting were Vannevar Bush (A'15, F'24), W. D. Coolidge (A'10, M'34), D. C. Jackson (A'87, F'12), A. G. Davis (A'98, F'12), H. T. Stetson, A. L. Rohrer (A'87, M'88), J. L. Haney, R. S. Morris, and K. T. Compton (F'31).

Following presentation of the papers, a talking motion picture in which Professor Thomson is interviewed on some of his more important accomplishments by the late E. Wilbur Rice, Jr., former president of the General Electric Company, was shown.

The old Central High School in Philadelphia, which Professor Thomson attended as a boy and at which he later became an instructor in chemistry and mechanics, is still standing and was open to inspection. Professor Thomson gave up his teaching

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New-Member Activity

New members are needed both to supply our natural losses and to maintain Institute progress. Have you assisted in bringing in a new member this year?

National Membership Committee

at this school in 1880 to join the newly formed American Electric Company in New Britain, Conn., the forerunner of the Thomson-Houston Electric Company, later consolidated with Thomas A. Edison's company in Schenectady to form the present General Electric Company. He died March 13, 1937. A charter member of the AIEE, he became its fifth president in 1889, and was elected to honorary membership in 1928.

American Engineering Council

Fact-Finding Inquiries

The patent inquiry now underway with funds provided by the National Industrial Conference Board, and under the direction of the AEC patents committee, directs attention to one of the primary opportunities for united action of engineers on public questions. A seven-page summary of these several fact-finding projects of the American Engineering Council is available on request.

American Engineering Council considers its opinions on public affairs are best expressed by the collection and interpretation and distribution of factual information. A brief list of these inquiries follows:

Twelve Hour Shift in American Industry. Published in book form by E. P. Dutton Company from monies supplied by the Cabot Fund. Price—$2.50

Waste in Industry. Published in book form by McGraw-Hill Book Company from monies furnished by the Russell Sage Foundation and individual contributions. Price—$2.50

Business Cycles and Unemployment. Published in book form by McGraw-Hill Book Company with funds provided by individual contributions. Price—$2.50

Industrial Coal—Purchase, Delivery and Storage. Published in book form by Ronald Press Company with funds secured from interested groups. Price—$2.50

Civil Aviation. Published in book form by McGraw-Hill Book Company with funds provided by Howard Coffin in co-operation with the Department of Commerce. Price—$2.50

Safety and Production. Published in book form by Harper and Brothers with funds contributed by National Bureau of Casualty and Surety Underwriters. Price—$2.50

Street Traffic Signs, Signals and Markings. Published in pamphlet form by American Engineering Council with funds from American Automobile Association, National Automobile Chamber of Commerce, and several street-railway companies. Price—$0.25

Recent Economic Changes. Published in co-operation with committee on recent economic changes by McGraw-Hill Book Company in two volumes. Three chapters on agriculture, technical changes in manufacturing industries, and changes in old and new industries, were prepared from funds supplied by the committee on recent economic changes. Price—$2.50 each

Airport Drainage and Surfacing. Published in pamphlet form by the Department of Commerce.

Survey of the Engineering Profession. Available in part in a series of pamphlets reprinted from the *Monthly Labor Review*, prepared by the Bureau of Labor Statistics with the co-operation of the member societies of American Engineering Council. (Articles reporting phases of this survey were published in ELECTRICAL ENGINEERING as follows: "Professional Aspects of Engineering Education," August 1936, pages 863–7; "Unemployment in the Engineering Profession," February 1937, pages 216–23; "Employment in the Engineering Profession," May 1937, pages 524–31; "Security of Engineering Employment," June 1937, pages 655–61; "Engineering Income and Earnings," September 1937, pages 1089–1104; "Sources of Engineering Income, 1929–34," November 1937, pages 1353–58; and "Monthly Earnings of Engineers, 1929–34," December 1937, pages 1450–60.)

Patent Inquiry. Now underway with funds provided by the National Association of Manufacturers and the National Industrial Conference Board to be published about January 1940.

In all these studies, Council approaches the problem from the viewpoint of the professional engineer, namely, first to assemble the facts; second, to analyze and co-ordinate them; and third, to recommend principles made evident by these facts. In the capital goods industries, construction industries, the extractive and public utilities industries, the engineer is professionally related both in fields of management and the field of technology. He brings to the consideration of public problems involving labor and capital and management practices and methods, the viewpoint of a professional man. In this viewpoint he seeks to express opinion based on facts, nonpartisan, nonpolitical, with the public good as the major objective. AEC seeks to maintain in all these undertakings a reputation for fairness and sound judgment, coupled with a practical understanding of the workings of industry and trade.

Letters to the Editor

CONTRIBUTIONS to these columns are invited from Institute members and subscribers. They should be concise and may deal with technical papers, articles published in previous issues, or other subjects of some general interest and professional importance. ELECTRICAL ENGINEERING will endeavor to publish as many letters as possible, but of necessity reserves the right to publish them in whole or in part, or reject them entirely.

ALL letters submitted for consideration should be the original typewritten copy, double spaced. Any illustrations submitted should be in duplicate, one copy to be an inked drawing but without lettering, and the other to be lettered. Captions should be furnished for all illustrations.

STATEMENTS in these letters are expressly understood to be made by the writers; publication here in no wise constitutes endorsement or recognition by the American Institute of Electrical Engineers.

Skew Factor for Coils in Skewed Slots

To the Editor:

It has been my experience to find that the derivation of the skew factor for coils which lie in skewed slots has been omitted from the more popular texts on a-c machinery. The analysis which leads to the determination of this factor is given below. A more general and comprehensive treatment of winding factors can be found in L. V. Bewley's paper "Induced Voltage of Electrical Machines" which appeared in the AIEE TRANSACTIONS for April 1930.

Referring to figure 1, the total flux linked by the skewed coil of one turn is

$$\phi = \sum_{M=1}^{\infty} \int_{-\frac{L}{2}}^{\frac{L}{2}} \int_{y\tan\theta}^{y\tan\theta+\tau} B_n \sin\left(\frac{nx\pi}{\tau}\right) dx\,dy \quad (1)$$

where

L = active length of conductor
y = axial distance along the core
θ = mechanical angle of skew
τ = pole pitch distance
B_n = maximum flux density of nth harmonic
x = peripheral distance
λ = electrical angle of skew

$$\phi = \sum_{M=1}^{\infty} \int_{-\frac{L}{2}}^{\frac{L}{2}} - \left| B_n \frac{\tau}{M\pi} \cos\left(\frac{Mx\pi}{\tau}\right) \right|_{y\tan\theta}^{y\tan\theta+\tau} dy \quad (2)$$

$$\phi = \sum_{M=1}^{\infty} - B_n \frac{\tau}{M\pi} \int_{-\frac{L}{2}}^{\frac{L}{2}} - \left\{ \cos\frac{M\pi}{\tau}(y\tan\theta+\tau) - \cos\left(\frac{M\pi}{\tau}\, y\tan\theta\right) \right\} dy \quad (3)$$

$$\phi = \sum_{M=1}^{\infty} B_n \frac{2\tau}{M\pi} \int_{-\frac{L}{2}}^{\frac{L}{2}} \times \cos\left(\frac{M\pi}{\tau}\, y\tan\theta\right) dy \quad (4)$$

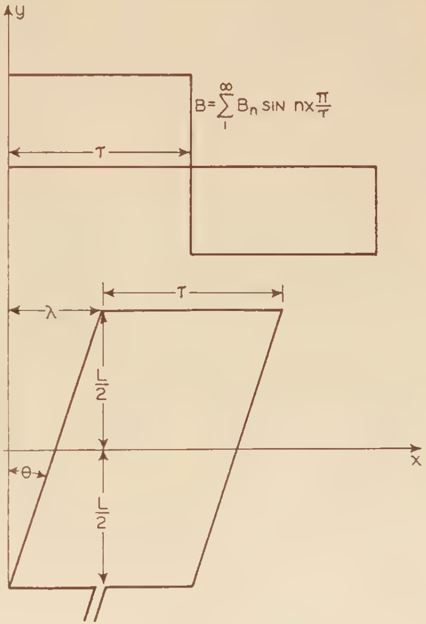


Figure 1

This follows from the fact that the space distribution of flux, normally does not contain even harmonics so that cos $n\pi = -1$.

$$\phi = \sum_{M=1}^{\infty} \frac{2}{\tan\theta} B_n \left(\frac{\tau}{M\pi}\right)^2 \times \Bigg|_{-\frac{L}{2}}^{\frac{L}{2}} \sin\left(\frac{M\pi}{\tau} y \tan\theta\right) \qquad (5)$$

$$\phi = \sum_{M=1}^{\infty} \frac{4}{\tan\theta} B_n \left(\frac{\tau}{M\pi}\right)^2 \times \sin\left(\frac{M\pi L}{2\tau} \tan\theta\right) \qquad (6)$$

where

$$\tan\theta = \frac{\lambda \times \tau/\pi}{L}$$

$$\phi = \sum_{M=1}^{\infty} 4 \times \frac{L}{\lambda \times \tau/\pi} B_n \left(\frac{\tau}{M\pi}\right)^2 \times \sin\left[\frac{M\pi L}{2\tau} \lambda \frac{\tau}{\pi} \frac{1}{L}\right] \qquad (7)$$

$$\phi = \sum_{M=1}^{\infty} \left(2LB_n \frac{\tau}{n\pi}\right) \frac{\sin n\lambda/2}{n\lambda/2} \qquad (8)$$

If $\lambda = 0$, then

$$\frac{\sin n\lambda/2}{n\lambda/2} = 1$$

so that the flux linked by the coil for zero skew is

$$\phi_{\lambda=0} = \sum_{M=1}^{\infty} 2LB_n \, \tau/n\pi \qquad (9)$$

From which it follows that the skew factor for the *n*th harmonic is

$$K_s = \frac{\sin n\lambda/2}{n\lambda/2}$$

Thus skewing the slots $\lambda = 2\pi/n$ electrical degrees will eliminate the *n*th harmonic.

Very truly yours,
D. L. Jaffe (A'35)

(Marcellus Hartley Laboratory, Columbia University, New York, N. Y.)

Personal Items

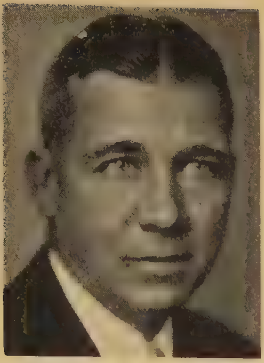
F. M. Farmer Nominated for Presidency

Frank Malcolm Farmer (A'02, M'12, F'13) vice-president and chief engineer of Electrical Testing Laboratories, New York, N. Y., has been nominated for the presidency of the AIEE for the 1939–40 term. Born at Ilion, N. Y., March 28, 1877, Mr. Farmer was graduated from Cornell University with the degree of mechanical engineer in 1899. In 1903, after $1^1/_2$ years in the test department of the General Electric Company at Schenectady, N. Y., and $2^1/_2$ years in the inspection division of the United States Navy at Brooklyn, N. Y., he joined the staff of Electrical Testing Laboratories, Inc. (then known as the Lamp Testing Bureau) as a technical assistant. He became engineer in 1906, chief engineer in 1912, and vice-president in 1929. Concurrently, he was instructor at Cooper Union night school of science from 1902 to 1906, serving under the late Professor William A. Anthony. Mr. Farmer has been particularly active at various periods in several standardization organizations: as chairman of two committees and as president (1924–25) of the American Society for Testing Materials; as chairman of two committees of the standards council of the American Standards Association and of the council (1936 to date); as a member of the electrical standards committee of the United States National Committee of the International Electrotechnical Commission, and the instruments and measurements committee of the power test codes committee of The American Society of Mechanical Engineers. He is a contributor to several reference books, and author of a book on electrical measurements and of many papers given before engineeering and technical societies. His Institute paper on "The Performance of High Tension Cables" in 1926 received both the national best paper prize and the regional best paper prize. He is at present a member of the board of United Engineering Trustees, Inc., and of the Engineering Societies monographs committee, and chairman of The Engineering Foundation, on all of which bodies he represents the Institute. He has served on the following Institute committees: standards, 1919–22, 1923 to date; power transmission and distribution 1920–1938; electric welding, 1927–28, 1930–31; research, 1929–1938 (chairman, 1933–36); technical program, 1933–36, 1938 to date; award of Institute prizes, 1933–36; executive, 1934–36, 1937 to date; and Edison Medal, 1934–38. In addition, Mr. Farmer has been a member of the Institute's board of examiners, 1923–28, 1936–38; chairman of the headquarters committee, 1936–38; and member of the Institute policy committee, 1937–38. He was a director from 1934 to 1938 and at present is serving as vice-president representing the New York City District (number 3). He is also a member of the finance committee and of the committee on transfers and is chairman of the committee on planning and co-ordination. In addition to his Institute activities, Mr. Farmer is a director of the American Standards Association; a past president of the American Society for Testing Materials; a past president of the American Welding Society; a fellow of the American Association for the Advancement of Science; a member of the Institution of Electrical Engineers (Great Britain) and of The American Society of Mechanical Engineers.

F. M. FARMER

Vice-Presidential Nominees Are Sinclair, George, Turner, Hitchcock, and Thomson

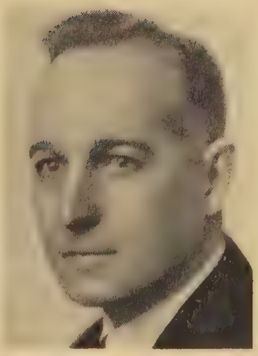
Carroll Taylor Sinclair (A'19, M'29, F'36) electrical engineer in the transmission and distribution division of Duquesne Light Company, Pittsburgh, Pa., has been nominated to serve the Institute as vice-president representing the Middle Eastern District (number 2). Born December 16, 1894, at Towson, Md., Mr. Sinclair was graduated from Baltimore Polytechnic Institute in 1913 and received a degree in electrical engineering from Lehigh University in 1917. That year he became an engineering assistant with the Western Union Telegraph Company, New York, N. Y., but later entered the United States Army. After his discharge as a second lieutenant of the engineers' corps, he became assistant testing engineer with the Pennsylvania Water and Power Company, Holtwood, in 1919. In 1922 he became assistant to the superintendent of stations, but he left later that year to join the United Electric Light and Power Company, New York, in the chief planning division. In 1923 he became superintendent of transmission and distribution. In 1925 he went to Pittsburgh as assistant electrical engineer in the transmission and distribution division of the Duquesne Light Company. In 1927 he was made electrical engineer for the Byllesby Engineering and Management Corporation, the name of which company, in Pittsburgh, became the Duquesne Light Company in the 1936 reorganization. Mr. Sinclair has written extensively, particularly on the subjects of transmission and distribution. He has also lectured at various universities and technical schools. He was editor-in-chief of the underground systems reference book published by the National Electric Light Association in 1931 and has been very active in that organization (now Edison Electric Institute). He is a member of the American Society of Civil Engineers. He has served the Institute as a member of the committees on power transmission and distribution, 1929–39 (chairman 1935–37); technical program, 1935–37; and standards, 1936–39, and was chairman of the Pittsburgh Section, 1930–31.


C. T. SINCLAIR

E. E. GEORGE

A. L. TURNER

H. W. HITCHCOCK


J. M. THOMSON

Everett Elwood George (A'20, M'29, F'36) superintendent of system operation, The Tennessee Electric Power Company, Chattanooga, has been nominated to serve the Institute as vice-president representing the Southern District (number 4). Born November 27, 1892, at Madison, Ind., Mr. George was graduated from Purdue University with a bachelor of science degree in 1913. His early employment was with the following companies: American Rotary Valve Company, Anderson, Ind. (test foreman, 1913); Barney and Smith Car Company, Dayton, Ohio (assistant efficiency engineer, 1914); National Steel Car Company, Hamilton County, Ohio (production engineer, 1915); Lodge and Shipley Machine Tool Company, Cincinnati, Ohio (plant engineer, 1916–17); Hercules Powder Company, Nitro, W. Va. (field supervisor, 1918); A. L. Drum and Company, Chicago, Ill. (valuation engineer, 1919); H. P. Gillette and Company, Chicago (valuation engineer, 1920); and R. M. Feustel and Company, Fort Wayne, Ind. (valuation engineer, 1921–22). In 1923 he went with the Tennessee Electric Power Company as a relay engineer, became superintendent of electrical operation in 1925, and superintendent of system operation in 1928. Mr. George has contributed to the technical press since 1919, has been very active in the Edison Electric Institute for many years, and is a member of the Institute of Radio Engineers. He was chairman of the East Tennessee Section of AIEE (1937–38) and served the Institute on the committees on protective devices (1928–31, 1935–37) and on communication (1936–39).

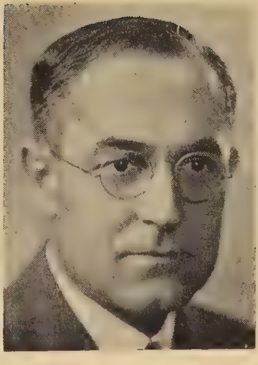
Albert Lange Turner (M'29) chief engineer of the Nebraska-South Dakota area of the Northwestern Bell Telephone Company, Omaha, Nebr., has been nominated to serve the Institute as vice-president representing the North Central District (number 6). Born at Owatonna, Minn., May 22, 1886, Mr. Turner started work in 1903 with the Northwestern Telephone Exchange Company at Owatonna and served that branch of the Northwestern system in various capacities from lineman to district plant chief. In 1919 he became plant chief of the Deadwood, S. Dak., district of the Nebraska Telephone Company and was later transferred to the Chaldron, Nebr., district. In 1920 he became construction engineer on the force of the division plant engineer at Omaha. The next year he was made exchange facilities engineer, on work covering the economic aspects as well as questions of engineering practice, with the chief engineer of the Northwestern Bell Telephone Company at Omaha. His subsequent titles were: engineer of outside plant estimates; engineer of transmission, protection, and foreign wire relations; engineer of plant extension; and chief engineer (since 1928). He served as chairman of the Nebraska Section of AIEE 1931–32.

Harry Williams Hitchcock (A'15, M'27, F'37) chief engineer of the Southern California Telephone Company, Los Angeles, has been nominated to serve the Institute as vice-president representing the Pacific District (number 8). Born January 1, 1890, at Lincoln, Nebr., Mr. Hitchcock received a bachelor of science degree from Pomona College in 1911, and later took two years' graduate work in physics and electrical engineering at Cornell University. From 1913 to 1921 he was in the transmission and development and research departments of the American Telephone and Telegraph Company, New York, N. Y. He left to do telephone transmission engineering with the Pacific Telephone and Telegraph Company at San Francisco, Calif., and worked with that company until 1924 when he went with the Southern California Telephone Company at Los Angeles. The first four years he was transmission and protection engineer but was made chief engineer in 1928. He has contributed to the technical press for many years. He served on the membership committee of the Institute (1933–35), and is a past chairman of the Los Angeles Section.

John Morton Thomson (A'26, M'30) chief designing engineer, Ferranti Electric, Ltd., Mount Dennis, Ont., Canada, has been nominated to serve the Institute as vice-president representing the Canada District (number 10). Born June 3, 1898, at Couva, Trinidad, British West Indies, Doctor Thomson was graduated from the University of Toronto in 1924. He later was awarded a master of applied science degree (1933) and a doctor of philosophy degree (1937) by that university. From 1920 to 1921 and during the summers of 1922 and 1923 he worked for the English Electrical Company of Canada at Toronto. He took the General Electric test course for graduate engineers (1924–25) and was made transformer designer with the English Electrical Company of Canada in 1925. He began his work with Ferranti Electric, Ltd., in 1926 as radio engineer and from 1928 to 1930 he was also responsible for the experimental and development work in connection with power and instrument transformers. Since 1930 he has been in charge of the designing department of that company, and has spent some time working in England. He has served the AIEE Canada District as secretary for several years. He is a member of the Institution of Electrical Engineers and of the Institute of Radio Engineers.

Eldredge, Hellmund, and Meyer Nominated for Institute Directorships

Mark Eldredge (A'14, M'20, F'33) chief engineer, Memphis Power and Light Company, Memphis, Tenn., has been nominated to serve the AIEE as a member of its board of directors. Born at Woodbury, N. J., May 17, 1882, Mr. Eldredge was graduated with a bachelor of science degree in electrical engineering from Worcester Polytechnic Institute, in 1906. He entered the testing department of the General Electric Company at Schenectady, N. Y., that year. In 1907 he was made an assistant electrical engineer in the United States Reclamation Service at Williston, N. Dak. From 1908 to 1911 he did varied electrical work in Utah and Colorado. He then went to Allahabad, India, where he was professor of electrical engineering at Ewing Christian College from 1911 to 1913. Next he became electrical assistant to the textile engineer, Tata Hydro-Electric Power Supply Company, Bombay, India, in 1913. From 1915 to 1917 he was distribution engineer with that company. In 1918 and 1919 he served as a captain in the United States Army at Port Clinton, Ohio. He returned to India in 1919 as superintendent of power with the Ludlow Jute Company at Calcutta. In 1922 he became assistant engineer with the Electric Bond and Share Company, New York, N. Y. He went with the Memphis Power and Light Company as chief engineer in 1924. He has been active over a period of years in the Edison Electric Institute and its predecessor organization, the National Electric Light Association. He was chairman of the Memphis Section of AIEE when it was organized (1930–31). He served as vice-president (1935–37) and was a member of the following committees: power transmission and distribution (1933–39), Sections (1934–37), Institute policy (1937–38), safety (1937–39), and also served on the special committee for consideration of broadening of Institute activities (August to October 1936).


F. J. MEYER

MARK ELDREDGE

Bachrach

R. E. HELLMUND

Rudolf Emil Hellmund (A'05, M'09, F'13) chief engineer of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., has been nominated to serve the AIEE as a member of its board of directors. Born February 2, 1879, at Gotha, Germany, Mr. Hellmund was graduated from the Technical College of Ilmenau, Germany, as an electrical engineer in 1889 and did post-graduate work at the University of Charlottenburg, Berlin, in 1901 and 1902. He worked at the designing of electric machinery at Poeschmann, Cologne, and Stuttgart before coming to the United States in 1903. That year he was with Krantz Company, Brooklyn, N. Y., working on the designing of circuit breakers. In 1904 he assisted Grant B. Rossman in the designing of a telegraphic device for transmitting drawings, and in 1905 went to Great Barrington, Mass., where he became associated with William Stanley in the designing of induction motors and a self-compounding alternator. From 1905 to 1907 he was in the engineering department of the Western Electric Company at Hawthorne, Ill. In 1907 he entered the engineering department of the Westinghouse company as a designer of induction motors and his progress has been recognized by various changes in title. He has been a prolific writer on technical subjects and has more than 300 patents. He was awarded the 1929 Lamme Medal of the AIEE, and in 1933 he was appointed chief engineer of the Westinghouse company, a position that had been held vacant since the death of Mr. Lamme in 1924. Mr. Hellmund has traveled extensively, representing Westinghouse in foreign fields, and has become especially well known for his interest in the training of young men. He is serving the Institute as chairman of the standards committee and as a member of the committee of planning and co-ordination. He also represents the Institute on the electrical standards committee and is on the standards council of the American Standards Association.

Frank J. Meyer (A'13, M'17, F'36) vice-president in charge of operation, Oklahoma Gas and Electric Company, Oklahoma City, has been nominated to serve the AIEE as a member of its board of directors. Born at Grant City, Mo., July 12, 1884, Mr. Meyer was with the Oklahoma Gas and Electric Company as a meterman from 1901 to 1904. He was graduated from Pratt Institute, Brooklyn, in 1906, and spent 18 months in Porto Rico as assistant to the chief engineer of the Guanica Centrale Sugar Company at Guanica. In 1907 he returned to the Oklahoma Gas and Electric Company as chief electrician, became general superintendent in 1920, assistant to the general manager in charge of operation in 1924, and vice-president in 1931. Mr. Meyer was vice-president of the Institute from 1934 to 1936 and has served on the following committees: power transmission and distribution (1934–36); general power applications (1934–38); and Edison Medal (1935–40).

W. I. Slichter
Renominated as Institute Treasurer

Walter Irvine Slichter (A'00, M'03, F'12) professor and head of the department of electrical engineering at Columbia University, New York, N. Y., has been renominated to serve the Institute as treasurer. Born May 7, 1873, at St. Paul, Minn., Professor Slichter was graduated from Columbia University in 1896 with the degree of electrical engineer. That year he entered the employ of the General Electric Company at Schenectady, N. Y. He spent one year in the testing department and five years as assistant to C. P. Steinmetz, doing experimental work and in the designing of all classes of a-c machinery, especially in the application of a-c motors to railway work. He then became assistant to the technical director, doing general engineering work of a consulting character as well as retaining charge of experimental work. In 1910 he began teaching electrical engineering at Columbia. From 1914 to 1917 he gave instruction to naval officers of the post-graduate school of the United States Navy on the design, construction, and operation of all electrical apparatus used on board naval vessels. Aside from serving the Institute as national treasurer since 1930, as manager (1918–22), and as vice-president (1922–24), he has acted on a great many committees.

W. D. COOLIDGE

W. L. R. EMMET

M. A. SAVAGE

M. A. Savage
to Receive Lamme Medal

Marion A. Savage (A'21) designing engineer of the General Electric Company, Schenectady, N. Y., has been awarded the Lamme Medal of the AIEE for 1938 "for able and original work in the development and improvement of mechanical construction and the efficiency of large high-speed turbine alternators." He was born at Walterboro, S. C., September 3, 1885, and received the degree of bachelor of science in electrical engineering at Clemson College in 1906. After graduation he obtained experience, while employed by the General Electric Company, as a student engineer in 11 different departments. In 1909 he was transferred to the turbine generator section of the a-c engineering department, and in 1923 was placed in charge of the section. He became designing engineer of the department in 1931. A Coffin Award was bestowed on him in 1932, a portion of the notation on the award stating "Mr. Savage has shown outstanding ability in design and development of large steam-driven generators. His designs have done much to permit trebling of the size of turbines in a comparatively short time. This growth has resulted in problems and risks of increasing magnitude. The excellence of these generators and the freedom from complaints testify to the quality of the job that he has done." During the past four years he has directed the development and novel engineering associated with the building of 28 large turbine generators which are cooled by means of hydrogen. Technical papers written by him have appeared in various publications, and one was presented at the World Power Conference in Berlin. Numerous patents relating to the construction of turbine generators have been awarded to him. The honorary degree of electrical engineer has been conferred upon him by Clemson College.

W. L. R. Emmet (A'93, HM'33) consulting engineer with the General Electric Company at Schenectady, N. Y., has received the David W. Taylor Medal awarded by the Society of Naval Architects and Marine Engineers for his "notable achievements in the advance and development of marine machinery, the most outstanding of which was the electric drive." Doctor Emmet was born July 10, 1859, at Pelham, N. Y., and was graduated from the United States Naval Academy in 1881. In 1910 the honorary degree of doctor of science was conferred on him by Union College, Schenectady, N. Y., and in 1925 a like honorary degree by Trinity College, Hartford, Conn. In 1887 he went with the Sprague Electric Railway and Motor Company, working in Richmond, Va., and Harrisburg and Pittsburgh, Pa. Later he was with the Westinghouse Electric and Manufacturing Company and with the Buffalo Railway Company, each for a short time, but went to Chicago, Ill., as district manager of the Edison General Electric Company after its formation. In 1892 he was transferred to New York as engineer in charge of the foreign department and was with the company when it became the General Electric Company. He holds more than 100 patents on electrical and allied apparatus, having done important work in steam turbine inventions and in the invention of the mercury-vapor power process. He was awarded the AIEE Edison Medal in 1919 and the Elliott Cresson Medal of the Franklin Institute in 1920. He served the AIEE as vice-president (1900–02) and as a member of several committees.

W. D. Coolidge (A'10, M'34) has been awarded the Faraday Medal for 1938 by the council of the Institution of Electrical Engineers (Great Britain). Doctor Coolidge, one of the foremost X-ray scientists in the world, was born at Hudson, Mass., October 23, 1873. He received the degree of bachelor of science in electrical engineering from Massachusetts Institute of Technology in 1896 and the degree of doctor of philosophy from the University of Leipzig in 1899. He combined teaching at Massachusetts Institute of Technology with research work with the General Electric Company for five years, leaving in 1905 to enter the research laboratories of the General Electric Company at Schenectady, N. Y. He became assistant director of research in those laboratories in 1908, associate director in 1928, and has been director since 1932. Doctor Coolidge received the Rumford Medal in 1914 for invention and application of ductile tungsten; the Howard N. Potts Medal in 1926; the Louis Edward Levy Gold Medal in 1926; the gold medal of the American College of Radiology in 1927; the Hughes Medal of the Royal Society, London, in 1927; the Edison Medal in 1927; the Washington Award in 1932; and the John Scott Medal in 1937. The Faraday Medal was founded in 1921 to commemorate the 50th anniversary of the first meeting of the Institution of Electrical Engineers and is awarded each year for notable scientific and industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science.

P. M. Lincoln (A'95, F'12) has retired as director of the school of electrical engineering of Cornell University at Ithaca, N. Y., and now is head of the Therm-Electric Meter Company. Professor Lincoln was born at Norwood, Mich., January 1, 1870, and was graduated as a mechanical engineer in electrical engineering from Ohio State University in 1892. He was then employed by the Brush Electric Company at Columbus, Ohio, but at the end of that year left to enter the testing department of the Westinghouse Electric and Manufacturing Company at East Pittsburgh, Pa. In 1895 he became electrical superintendent with the Niagara Falls Power Company, but in 1902 returned to Westinghouse to be in charge of the power division of the engineering department. He was appointed general engineer for the company in 1910, and remained there until 1919, at the same time being head of the engineering school of the University of Pittsburgh (1911–15). In 1919 he joined the firm of his brother, The Lincoln Electric Company of Cleveland, Ohio, as consulting engineer. In 1922 he became director of the school of electrical engineering at Cornell. His formal retirement took place in June 1938, but he continued as acting director until February 1, 1939. Professor Lincoln is a member of several scientific and engineering societies, and in 1902 was awarded the John Scott Medal for his invention of the synchroscope. He was a manager of the Institute from 1906 to 1909, vice-president from 1909 to 1911, and president from 1914 to 1915. He has also served on many committees of the Institute during the past quarter of a century.

W. A. Kietzman (M'23) has been appointed vice-president and general manager of the upstate area, New York Telephone Company, Albany. Born September 7, 1888, at Eau Claire, Wis., Mr. Kietzman was granted the degree of bachelor of science in electrical engineering by the University of Wisconsin in 1912. That year he entered the commercial engineering department of the American Telephone and Telegraph Company as a student engineer. He was advanced to assistant engineer and then to exchange rate practice engineer. During the World War he served in the motor equipment section and requirements division of the ordnance department of the United States Army and was a member of the Stettinius Mission to France. After his discharge with the grade of first lieutenant, Mr. Kietzman returned to the American Telephone and Telegraph Company as a cost engineer. In 1921 he went with the Bell Telephone Company of Pennsylvania at Philadelphia as general commercial engineer. Five years later he returned to the American Telephone and Telegraph Company as sales and directory engineer. He came to the New York Telephone Company in 1928 as general commercial manager of the Manhattan area, a position which he held until his recent promotion and transfer.

W. O. Turner (A'31) has been elected president and general manager of the Louisiana Power and Light Company, Algiers. Mr. Turner was born at Lonoke, Ark., March 19, 1897 and received the degree in electrical engineering from the University of Arkansas in 1919. From 1919 to 1922 he was resident engineer with the Little Rock Railway and Electric Company at Little Rock, Ark. In 1922 he became resident engineer and construction superintendent with the Phoenix Utility Company and in 1927 was made resident supervising engineer with Electric Bond and Share Company, doing work in Tennessee, Florida, and Louisiana. In 1928 he went with Louisiana Power and Light Company as chief engineer, was made a director of the company in 1933, and became vice-president in 1936.

W. A. Lewis, Jr. (A'27, M'29) has been appointed director of the school of electrical engineering in the College of Engineering at Cornell University, Ithaca, N. Y. Doctor Lewis was born at Harriman, Tenn., January 21, 1904, and in 1920 became an electrical draftsman and switchboard engineer with the Westinghouse Electric and Manufacturing Company at Los Angeles, Calif. In 1922 he received the Westinghouse War Memorial Scholarship contributing toward the four years' course in engineering at California Institute of Technology. He was granted a bachelor of science degree (with honor) in 1926, a master of science degree (with honor) in 1927; and a doctor of philosophy degree

P. M. LINCOLN

W. A. KIETZMAN

W. O. TURNER

in 1929, the only student of electrical engineering ever to receive that degree *summa cum laude* from that institution. As winner of a junior travel prize in 1925, he studied for one summer in Europe, but worked for the Westinghouse company during other summers when he was attending the university. Since 1929 he has been employed in the central station engineering department of the Westinghouse company at East Pittsburgh, Pa., specializing in transmission and problems relating to steam-railroad electrification. He has also been a Westinghouse lecturer in electrical engineering at the University of Pittsburgh and has given evening courses for engineers of several power and light companies. He has published articles on technical subjects and is co-author of a book on symmetrical components.

H. H. Weber (A'27, M'29) has been appointed commercial engineer of the wire sales department of the United States Rubber Company, New York, N. Y. Since 1934 he had been assistant manager of that department. Mr. Weber studied electrical engineering at Bliss Electrical School, Washington, D. C., and later attended Lehigh University. From 1917 to 1919 he served with the engineers corps of the United States Army in France and in the United States. In 1919 he was an engineer with the Utica Gas and Electric Company, but in 1920 became engineer and chief electrical inspector with the New York State Fire Insurance Rating Organization at Jamestown and Syracuse. In 1924 he went with the Rome Wire Company in Rome, N. Y., and was later transferred to that company's offices in New York City. Before going with the United States Rubber Company he had been director of low-voltage engineering with the General Cable Corporation, New York, since 1930.

A. A. Frank (A'03, M'31) has retired from the position of chief engineer of the New York Telephone Company, Manhattan area, New York. Born in New York City on September 14, 1877, Mr. Frank attended the College of the City of New York for $2^{1}/_{2}$ years and then continued his education at Columbia University, graduating in 1900. In 1901 he became engineering assistant with the New York and New Jersey Telephone Company. Here he had an important part in the original subway engineering for Long Island and northern New Jersey. In 1909 he was made fundamental plans engineer with the New York Telephone Company and ten years later was given the title of engineer of fundamental plan and subway requirements. In 1920 he became engineer of exchange plant extension and was appointed chief engineer of downstate New York in 1925. He had served as chief engineer of the Manhattan area since 1927.

F. P. Lawrence (A'25) formerly vice-president and general manager of the upstate area has been transferred from Albany to New York by the New York Telephone Company to become vice-president and general manager of the Manhattan area. A student of civil engineering at Lehigh University in the class of 1910, Mr. Lawrence spent two years in the construction industry and then started his telephone career with the Southwestern Bell Telephone Company at St. Louis, Mo., in 1912. He entered the employ of the New York Telephone Company in 1929 as general plant manager in the upstate area and became vice-president and general manager of that area in 1934.

R. M. Morris (M'28) has been elected vice-president in charge of personnel operations, rates, and franchises by the Mountain States Telephone and Telegraph Company, Denver, Colo. Mr. Morris started with the Mountain States company in the plant department at Denver in 1905. He became wire chief at Cripple Creek in 1907 and manager in 1909. In 1910 he became district manager, located at Durango, but returned to Denver in 1916 as commercial engineer. The next year he went to Helena, Mont., as division commercial superintendent, but again returned to Denver in 1920 as commercial engineer and rate expert. In 1923 he became general commercial manager and previous to his present appointment had been assistant vice-president.

R. M. MORRIS

L. R. Milburn (A'20, M'31) has been elected chairman of the Detroit district section of the Association of Iron and Steel Engineers. A graduate of the University of Michigan, Mr. Milburn served with the United States Army signal corps in 1918. From 1919 to 1924 he was with the General Electric Company doing testing, sales, and engineering work at Schenectady, N. Y., and Cleveland and Cincinnati, Ohio. From 1924 to 1929 he did general electric engineering work on construction with the Louisville Gas and Electric Company, Louisville, Ky. In 1929 he became assistant electrical engineer for the Great Lakes Steel Corporation, Ecorse, Mich., was made acting electrical engineer in 1933, and electrical engineer in 1935.

E. M. Richards (M'25) has been made assistant vice-president in charge of operations by the Republic Steel Corporation, Cleveland, Ohio. Mr. Richards was graduated with the degree of bachelor of science in electrical engineering from Bucknell University in 1913 and was awarded the honorary degree of electrical engineer in 1919. He went with the Westinghouse Air Brake Company, Pittsburgh, Pa., as a testing engineer. In 1915 he was made assistant to the chief engineer and in 1917, assistant to the manager of engineering. From 1920 to 1925 he was with H. O. Swoboda, Inc., Pittsburgh, Pa., first as consulting electrical and mechanical engineer and then as vice-president. In 1925 he went with the Jones and Laughlin Steel Corporation at Aliquippa, Pa., as chief industrial engineer, but left to occupy a like position with the Republic Steel Corporation in 1930. He had been assistant to the vice-president since 1935.

G. C. Barney (M'37) has been transferred to the department of operation and engineering (transmission section) of the American Telephone and Telegraph Company, New York, N. Y. Mr. Barney was graduated from the University of Maine in 1924 with a degree in electrical engineering. During 1918 and 1919 he had charge of radio operations at Poitiers, France, and during 1920 and 1921 in Vienna, Austria. He went with the New England Telephone and Telegraph Company at Providence, R. I., in 1926. In 1929 he came to New York in the transmission engineer's department of the American Telephone and Telegraph Company. Since 1935 he has been located in London, England, as assistant to the technical representative in Europe.

R. S. Bailey (M'31) has been appointed price survey engineer, reporting to the operating results engineer of the American Telephone and Telegraph Company, New York, N. Y. He was graduated from Lowell Institute as an electrical engineer in 1917 and later took night work at Massachusetts Institute of Technology. Mr. Bailey started with the New England Telephone and Telegraph Company in 1908, working in Lowell during the time he went to school. In 1919 he entered the engineering department of the American Telephone and Telegraph Company in New York. He holds many patents on circuit arrangements for telephone switching systems.

C. M. Brentlinger (A'19, M'27) has been appointed general superintendent of traffic of the Western Union Telegraph Company, New York, N. Y. Born December 10, 1893, at Freelandville, Ind., Mr. Brentlinger was graduated from the University of Illinois in

C. M. BRENTLINGER

1916 with the degree of bachelor of science in electrical engineering. That year he went with the Western Union Telegraph Company, New York, as engineering assistant in the office of the vice-president in charge of traffic. His progress in the company was marked by the following changes in title: general inspector in 1920, general traffic supervisor in 1928, and central division traffic superintendent in 1931. During the seven years that he held the last-named position, Mr. Brentlinger made his headquarters at Omaha, Nebr.

R. C. Newhouse (A'31) has been awarded the Lawrence Sperry Award for 1938 by the Institute of Aeronautical Sciences "for the development and first practical application of the terrain clearance indicator." Mr. Newhouse was graduated from Ohio State University with the degree of bachelor of electrical engineering in 1929 and received the degree of master of science in 1930 while continuing at Ohio State University as a fellow under the Guggenheim Fund for the Promotion of Aeronautics. Since 1930 he has been a member of the technical staff of the Bell Telephone Laboratories, Inc. New York, N. Y., engaged in radio transmitter development.

A. F. Rose (A'19, M'22) has been made electrical engineer in charge of the toll group of the American Telephone and Telegraph Company, New York, N. Y. Graduated from Colorado College in 1914 with the degree of bachelor of science in electrical engineering, Mr. Rose has been continuously employed by the company since that time. He has had responsibility for important electrical engineering work having to do with the use of telephone repeaters on open wire and cable circuits as used by the Bell System. Until recently he was in charge of the exchange and special services group.

D. H. Robinson (M'36) has been made executive engineer of the construction division of the public works department, electricity branch, at Lahore (Punjab), India. Mr. Robinson was born at Wolstanton Stoke on Trent, England, October 17, 1892, and received his education at Armstrong College, Durham University. His work as an engineer (aside from that done in England, Scotland, and Wales) has taken him to foreign fields for long periods of years. After experience in Berlin, Siam, Egypt, and the Straits Settlements, he went to India in 1934, and until recently was at Amritsar.

R. A. Galbraith (A'38) has transferred from the staff of the electrical engineering department of the University of Missouri, Columbia, to the staff of the University of Texas, Austin, as assistant professor of electrical engineering. Mr. Galbraith received the degree of bachelor of science in electrical engineering at the University of Missouri in 1933 and was awarded the degree of doctor of philosophy by Yale University in 1937. From 1937 to 1938 he was an electrical engineer in the research department of the Detroit Edison Company at Detroit, Mich.

T. W. Eadie (A'27) has been made western division plant supervisor of the Bell Telephone Company of Canada. Mr. Eadie was graduated from McGill University with a degree in civil engineering. During the summers he had been employed by the Bell company on power developments and in 1923 started regular employment in the fundamental engineer's office of that company. He became toll and transmission engineer of the central division in 1927. Prior to his recent appointment, he had been general plant supervisor at Toronto.

O. P. Cleaver (A'36) has been appointed a member of the executive committee of the Better Light-Better Sight Bureau. Mr. Cleaver was graduated from Georgia School of Technology in 1928 and was granted a master of science degree in electrical engineering by Yale University in 1930. Since that time he has been an illuminating engineer with the Westinghouse Electric and Manufacturing Company at Bloomfield, N. J., and is now in charge of the commercial engineering department of the lamp division.

J. A. Mathews (A'37) is now junior engineer with the United States Bureau of Mines, Central Experiment Station, Pittsburgh, Pa. He received the bachelor of science of electrical engineering degree from the University of Maryland in 1928 and the master of science degree in electrical engineering from Massachusetts Institute of Technology in 1930. Previous to this recent appointment he was an instructor at Wyomissing Polytechnic Institute, Wyomissing, Pa.

Robert Loewe (A'32) is now employed as an electrical engineer with the Commonwealth and Southern Corporation at Jackson, Mich. Mr. Loewe took his electrical engineering work at the University of Wisconsin, graduating in 1930 and later continuing graduate work there. He had been employed as distribution transformer design engineer with the Westinghouse Electric and Manufacturing Company at Sharon, Pa.

P. H. Williams (A'35) has been appointed district plant superintendent with the American Telephone and Telegraph Company at Detroit, Mich. Mr. Williams received a bachelor of science degree from the University of Minnesota in 1922. His entire professional experience has been with the long lines department of the American Telephone and Telegraph Company. Just previous to this change he was area plant supervisor, Chicago, Ill.

R. F. Davis (A'25) has been placed in charge of the exchange and special services group of the American Telephone and Telegraph Company, New York, N. Y. He was graduated as an electrical engineer from Cornell University in 1921 and has been in the engineering department of the American Telephone and Telegraph Company since that time. Until recently he had been in charge of the electrical co-ordination group (transmission section).

B. K. Boyce (A'10, M'28) formerly chief engineer of the upstate area, has been transferred from Albany to New York by the New York Telephone Company and is now chief engineer of the Manhattan area. Mr. Boyce has been with the New York Telephone Company ever since his graduation from Cornell University in 1907. He had been chief engineer of the upstate area since 1926. He served the Institute on the committee on communication, 1930–31.

H. P. Sherer (A'35) was named among the winners of the 1938 awards of the James F. Lincoln Arc Welding Foundation. His paper concerning fans for electrical machines received fourth award in subclass *J*-3, functional machinery, electrical. An electrical engineering graduate of Ohio State University in 1934, Mr. Sherer is employed by Imperial Electric Company, Akron, Ohio.

David Sarnoff (M'23) was presented with the Gold Medal Achievement Award of the Poor Richard Club (advertising) at Philadelphia, Pa., on January 17, 1939, in "recognition of outstanding contributions to the advancement of American industry." Mr. Sarnoff has been president of the Radio Corporation of America, New York, N. Y., since 1930.

G. F. Stark (A'38) is now electrical engineer with the Stark Electrical Company of Baltimore, Md. A graduate of Johns Hopkins University in 1937, Mr. Stark had been employed as an electrical engineer with the Westinghouse Electric and Manufacturing Company at East Pittsburgh, Pa. and with the Westinghouse Electric International Company, New York, N. Y.

Macklen Kleiman (A'37) has been made engineer and assistant to the president of the Melrose Curtain Company, Inc., Boston, Mass. Graduated from the Massachusetts Institute of Technology as an electrical engineer in 1936, Mr. Klieman had been a welding engineer in the Lycoming Division of the Aviation Manufacturing Corporation at Williamsport, Pa.

Vannevar Bush (A'15, F'24) has been elected to life membership in the corporation of the Massachusetts Institute of Technology. Doctor Bush was formerly vice-president and dean of engineering of Massachusetts Institute of Technology and is now president of the Carnegie Institution, Washington, D. C.

L. R. Schumacher (A'32) is now junior engineer on hydroelectric power plant design with the Bureau of Reclamation at Denver, Colo. Mr. Schumacher was graduated from South Dakota State College in 1930 and had been a junior engineer with the United States Engineers at Fort Peck, Mont.

B. H. Carter (A'31) has been made field engineer with the Rural Electrification Administration at Madison, Wis. He had previously been a junior engineer with the United States Engineers at Zanesville, Ohio. He received his degree in electrical engineering from Ohio State University in 1929.

G. V. Harrap (A'34) has been made technical assistant to the West Ham Corporation Electricity Department at West Ham, London, England. He was formerly assistant engineer in the Corporation Electricity Department at Hull, Yorkshire, England.

W. E. Brainard (A'33) has been employed as plant superintendent of the Weldrods Corporation at Cuyahoga Heights, Ohio. He was graduated from Cornell University in 1931 and had been production engineer with the Wilson Welder and Metals Company, Inc., at North Bergen, N. J.

R. E. Higgins (A'35) who has been with the Santa Fe Railroad at Needles, Calif., since 1931, recently has been made maintenance foreman of that company's ice plant at Bakersfield, Calif. Mr. Higgins was graduated from the University of California in 1928.

T. W. Reynolds (A'36) now is employed as development engineer by the Bendix Aviation Corporation at Bendix, N. J. He was formerly an engineer in the experimental department of the Pioneer Instrument Company, Brooklyn, N. Y.

F. E. Swift (A'16, M'30) has been transferred by the civil service department of the State of Michigan from Newberry State Hospital, Newberry, to the State Prison of Southern Michigan at Jackson as steam electric engineer.

A. J. Fischer (A'36) is now metallurgist with American Cutting Alloys at Lewiston, Maine. A graduate of Pratt Institute in 1934, Mr. Fischer was formerly metallurgist with the Metal Powders Processing Company, Inc., Long Island City, N. Y.

F. W. Atkinson (A'31, M'37) electrical engineer with the Owens-Illinois Glass Company at Newark, Ohio, is now, since the formation of a new company, with the Owens-Corning Fiberglas Corporation.

Obituary

Cary Talcott Hutchinson (A'90, M'90, F'12) died at Coral Gables, Fla., January 16, 1939. Doctor Hutchinson was born March 4, 1866, at St. Louis, Mo., and was graduated from Washington University, St. Louis, in 1886. He received the degree of doctor of philosophy from Johns Hopkins University in 1889. From 1889 to 1891 he was with the Sprague Electric Railway Company and was closely associated with the designing and building of the first electric locomotive in the United States for use in the Chicago freight terminals. From that time until 1923 he was engaged in practice as a consulting engineer, the firm name from 1892 to 1894 having been Sprague, Duncan, and Hutchinson. Much of his work was with commissions working on the electrification of railways, among the most important having been the Baltimore and Ohio, the Great Northern, the Northern Pacific, the Rapid Transit of New York City, the Illinois Central, and the Maine Central. From 1906 to 1908 he was engaged by the Great Northern Railway in the design and construction of the electric equipment of its road over the Cascade Mountains, one of the first three-phase electrifications to be built in the United States. He also did pioneer work in studying the possibilities of hydroelectric development of the Susquehanna River, his efforts resulting in the underwriting and construction of the dam and power station at McCall Ferry, Pa., a plant which supplies Baltimore with electric service and has transmission lines extending to Safe Harbor, York, and Coatesville, Pa. In 1923 Doctor Hutchinson joined the engineering firm of Sanderson and Porter, New York, as associate consulting engineer. Here he was active on electric light, power, and transmission and transportation work until his retirement in 1932. Doctor Hutchinson contributed widely to publications on the electrification of railroads and was the first secretary of the National Research Council and of the Engineering Foundation, having served both of those bodies during the World War. He was a manager of the Institute (1895–98), vice-president (1898–1900), and served on the National Research Council, division of engineering (1925–29). He was also a member (1925–26) of the committees on transportation and meetings and papers.

Charles Shumway Ruffner (A'02, M'08, F'12) died at Fort Meyers, Fla., January 21, 1939. Mr. Ruffner was born June 22, 1880, at Chicago, Ill., and was graduated from the University of Missouri in 1900. He started work that summer with the Missouri Edison Company of St. Louis, but in September went with the Telluride Power Company, working in Utah and Colorado. From 1909 to 1911 he was with the Central Colorado Power Company at Denver and from 1911 to 1913 with the Mississippi River Power Distributing Company of St. Louis. From 1914 to 1916 he was vice-president of the Electric Company of Missouri at Webster Groves and from 1917 to 1919, vice-president of the Union Light and Power Company, St. Louis. In 1919 he became vice-president of the North American Company which controlled the Union Electric Light and Power Company. In 1921 he became vice-president and general manager of the Adirondack Power and Light Company; in 1925, president of the Mohawk-Hudson Power Company; and in 1927, president of the New York Power and Light Corporation. He had been vice-president of the Niagara-Hudson Power Company while serving in other capacities in that group. He retired in 1929 but remained chairman of the board of directors of the Schenectady Trust Company, Schenectady, N. Y. Mr. Ruffner served the Institute as a manager (1916–20), as vice-president (1920–21), and was active on many committees.

Paul Doty (A'04, M'12) died December 3, 1938. Born May 30, 1869, at Hoboken, N. J., Mr. Doty was graduated from Stevens Institute of Technology in 1888 with the degree of mechanical engineer, but later took special work in electrical engineering at the University of Colorado. From 1888 to 1895 he was with the United States Gas Improvement Company, starting as a cadet engineer in the Philadelphia, Pa. plant and being later transferred to Jersey City and Paterson, N. J. From 1895 to 1898 he was vice-president and general manager of the Consolidated Gas Company of New Jersey, Long Branch. In 1903 he took a similar position with the Denver Gas and Electric Company, Denver, Colo. In 1904 he went with the McMillin interests and was vice-president and general manager of the Edison Electric Light and Power Company, St. Paul, Minn.; vice-president of the St. Croix Power Company, St. Croix, Wis.; and vice-president and general manager of the St. Paul Gas Light Company, and from 1905 to 1910 was president of the Union Light, Heat and Power Company of Fargo, N. Dak. In 1917 he relinquished his various utility interests to serve the United States in the World War. He was a major in the corps of engineers from 1917 to 1919 and was detailed to give advice on construction projects for the army to the Secretary of War. In 1919 he was commissioned lieutenant-colonel, a title which he subsequently held in the reserve corps of the United States Army. He was also brigadier general on the general staff corps of the Minnesota National Guard. At the time of his death Mr. Doty was chairman of the Minnesota Board of Registration for Architects and Engineers, St. Paul, and had been active in civic affairs over a period of years.

William Thomas Ryan (A'07, M'12) died February 5, 1939. Professor Ryan was born at Bristol (now Joice), Iowa, February 28, 1882, and was graduated in electrical engineering from the University of Minnesota, Minneapolis, in 1905. For two years he was with Westinghouse Electric and Manufacturing Company at Salt Lake City, Utah, and the General Electric Company, Schenectady, N. Y. In 1907 he returned to the University of Minnesota as an instructor in the engineering department, was made assistant professor in 1909, associate professor in 1919, and had been professor of electric power engineering since 1922. He was the author of a three-volume work on the design of electrical machinery and of many technical papers. During the years he was with the university, he also did consulting work in Minnesota and South Dakota and served on the Minnesota Tax Commission. He was vice-president of the Institute from 1928 to 1930 and served on the following committees: production and application of light (1928–30) and education (1929–33). He was active in the work of the Minnesota Section of AIEE and was serving as chairman of the local District meeting committee at the time of his death.

Hugh Julius Glaubitz (M'17) assistant professor at the school of technology of the College of the City of New York, New York, died on January 14, 1939. Doctor Glaubitz was born in Neunmuenster, Germany, in 1875 and came to the United States in 1892. He was graduated from the University of Pittsburgh in 1896 with a degree in civil engineering. He started work as a structural designer with Carnegie Steel Company, Pittsburgh, Pa., in 1896 and became a United States citizen in 1898. From 1898 to 1901 he was with Julian Kennedy, Pittsburgh, Pa.; a consulting engineer on blast furnace, coke oven, and rolling mill construction. From 1901 to 1903 he was again with Carnegie Steel Company as construction engineer of blast furnaces; and for a short time in 1903 he was with the Lackawanna Iron and Steel Company as an engineer. From 1904 to 1908 he was with the National Electric Signaling Company, doing design and construction work on wireless plants and assisting in the management of European affairs. From 1908 to 1911 he was a consulting engineer at Toronto, Canada, working on high-voltage transmission lines and water works. From 1911 to 1915 he was general manager of the Public Utilities Commission, London, Canada, acting as consulting engineer on electrical and water works. He became vice-president of The Sothman Corporation, New York, in 1915. From 1918 to 1928 he was engaged in independent consulting work and in 1928 became division engineer with the Public Service Production Company, Newark, N. J. In 1933 he engaged in teaching at Nassau Collegiate Center and from September 1936 until his death had been at the College of the City of New York.

William Francis Dawson (A'05, M'13, F'29) died January 17, 1939. Mr. Dawson was born at Andover, Mass., February 10, 1868. In 1886 he was graduated from the school of mechanic arts conducted by Massachusetts Institute of Technology, and later took courses at Lowell Institute. He served a three-year apprenticeship as machinist in the locomotive repair shops of the Boston and Albany Railroad, at Boston. In 1890 he entered Thomson-Houston Electric Company at Lynn, Mass., which company was later consolidated with the Edison General Electric Company. In 1894 he was transferred to Schenectady, N. Y., as a draftsman and from 1895 to 1905 he was in the engineering department, where he had an important part in the designing of d-c generators. From 1905 to 1910 he was at Rugby, England, in charge of the designing of d-c motors and generators for the British Thomson-Houston Company, Ltd. In 1910 he returned to the General Electric Company at Schenectady, and the next year was transferred as a designing engineer to the generator section of the river works turbine section at West Lynn, Mass., where he remained until his retirement. He was responsible for many improvements in turbine generators. During the past few years Mr. Dawson had been living at Holliston, Mass.

Clarence Irving Brown Henning (A'13) died on January 26, 1939, at Berkeley, Calif. Born at Los Gatos, Calif., May 31, 1881, Mr. Henning was graduated from the California School of Mechanical Arts, San Francisco, in 1898 and attended the University of California. In 1901 Mr. Henning went with the California Powder Works at Pinole, having gained his first experience in the chemistry of explosives as assistant to the dean of the college of chemistry of the University of California. He was first employed by the E. I. du Pont de Nemours and Company, Inc., at the Haskell (N. J.) smokeless powder plant in 1907 and later became internationally known as a smokeless powder chemist. In 1913 he was appointed ballistics engineer at the company's experimental station in Wilmington, Del. In 1917 he was technical adviser on explosives to the British Ministry of Munitions in London. From 1921 until his retirement in 1932, Mr. Henning was assistant director of military sales in charge of technical matters of the explosives department of the du Pont Company at Wilmington. For several years Mr. Henning was president of the Sporting Arms and Ammunition Manufacturers' Institute and was a member of the National Rifle Association.

Michael Wittenberg (M'24) who had been engaged in the insurance business in New York, N. Y., for more than a decade, died in January 1939. Born August 20, 1873, at Polotzk, Russia, Mr. Wittenberg attended the University of Bern, Switzerland, and received his degree in electrical engineering at the Polytechnicum, Darmstadt, Germany. After doing consulting work for various municipal administrations in Russia from 1902 to 1904, he became vice-president and manager of Electricheskaya Energia, in St. Petersburg. In 1906 he became associated with the Russian Westinghouse company at St. Petersburg, but left in 1913 to join the Russian General Electric Company at Moscow in the department of planning and installation of large power plants. From 1920 until he came to the United States in 1924 he was chief electrician with the Concessioners of the Electric Light and Tramway System, Harbin, Manchuria. In the United States Mr. Wittenberg was with the Pennsylvania Power and Light Company at Allentown a short time before he left electrical engineering for insurance work.

Frederick William Insull (M'37) died at Tulsa, Okla., on January 14, 1939. Mr. Insull was born in England, July 5, 1875, and received his education in the public schools of Winnipeg, Canada. In 1902 he became secretary and treasurer of the Evanston Electrical Illuminating Company, Evanston, Ill. From 1902 to 1909 he was secretary and treasurer of the North Shore Electric Company (now the Public Service Company of Northern Illinois) at Chicago. In 1909 he was auditor for the Northern Idaho and Montana Power Company and in 1910 and 1911 auditor with the H. M. Byllesby Company at Portland, Ore., and then auditor for the Arkansas Valley Light and Power Company at Pueblo, Colo. (1911–12). In 1913 he founded and became president of the Public Service Company of Oklahoma, a position which he held until his death, concurrently having been vice-president or president of several affiliated companies of the Midwest Utilities group.

Robert Carr Lanphier, Sr. (A'01, M'07, F'13) died January 28, 1939, at Springfield, Ill. Born January 25, 1878, at Springfield, he was graduated from Yale University with a degree of bachelor of philosophy in electrical engineering in 1897. For the first two years following graduation he was engaged in the development of electric meters in the shops of the Illinois Watch Company in Springfield, but in 1899, with Jacob Bunn, founded and organized the Sangamo Electric Company. He started as superintendent and electrical engineer, became secretary and manager in 1906, and later was made vice-president. Upon the death of Mr. Bunn in 1926 he became president, a post he held until his death. British Sangamo, Ltd., was organized in 1920 at Enfield, England, and the Canadian branch was established at Toronto in 1930.

Nelson E. Buck (A'19) died December 12, 1938. Born January 22, 1884, at Elgin, Ill., Mr. Buck studied electrical engineering through the International Correspondence Schools. From 1901 to 1902 he was engineer with the Elgin Public Schools and for a short time with the Elgin Manufacturing Company. Later in 1902 he became substation operator with the Aurora, Elgin, Chicago Railway. In 1903 he became electrician with the Sterling Boiler Company and later that year, chief engineer with the Barberton Electric Company. In 1905 he started as substation operator with Commonwealth Edison Company and worked with that company in various capacities until his death. Since 1915 he had been superintendent of the underground division in the construction department at Chicago, Ill.

Samuel Noble Roberts (A'21) died in January 1939 at Atlanta, Ga. He was born June 21, 1886, at Anniston, Ala., and studied at the Georgia School of Technology. From 1907 to 1909 he was with Westinghouse Electric and Manufacturing Company. From 1909 to 1910 he was employed by the Southern Iron and Steel Company at Gadsden, Ala., but during the last six months of 1910 was with the United States Cast Iron Pipe and Foundry Company, Anniston, Ala. From 1911 until his death he was with the Atlantic Steel Company at Atlanta, Ga. Starting as chief electrician, he became electrical and mechanical superintendent in 1920, a position which he held until his death.

Charles Frederick Hopewell (A'97, M'18) died October 17, 1938. Born at Boston, Mass., June 1, 1872, Mr. Hopewell was graduated as an electrical engineer from Massachusetts Institute of Technology in 1894. That year he went with Goodall Worsted and Sanford Mills, Sanford, Maine, but the next year was employed in the testing department of the Stanley Electric Company at Pittsfield, Mass. From 1895 to 1903 he was city electrician, Cambridge, Mass. He then did experimental work as a partner in the Uni Signal Company for two years. From 1905 until his recent retirement he was a member of the firm of Hopewell Brothers, manufacturers of automobile specialties at Watertown, Mass.

Glendon C. Brown (M'37) electrical engineer with Cutler-Hammer, Inc., Milwaukee, Wis., died in 1938. Mr. Brown was born January 2, 1907, at Fargo, N. Dak., and was graduated from the University of Minnesota with the degree of bachelor of science in electrical engineering in 1928. That year he entered Cutler-Hammer, Inc., as a research engineer. He was granted many patents on electronic speed regulators and controllers and other original designs.

Membership

Recommended for Transfer

The board of examiners, at its meeting on February 16, 1939, recommended the following members for transfer to the grade of membership indicated. Any objection to these transfers should be filed at once with the national secretary.

To Grade of Member

Bingham, L. A., assistant professor of electrical engineering, University of Nebraska, Lincoln.
Browder, J. D., assistant electrical engineer, Oklahoma Gas and Electric Company, Oklahoma City.
Galphin, C. B., engineer, R. H. Bouligny, Inc., Charlotte, N. C.
Huber, G. H., member of technical staff, Bell Telephone Laboratories, Inc., New York, N. Y.
Lyons, J. M., assistant design engineer, General Electric Company, West Lynn, Mass.
Monseth, I. T., southwestern engineering manager, Westinghouse Electric and Manufacturing Company, St. Louis, Mo.
Rudelius, C. E., junior engineer, Northern Indiana Public Service Company, Hammond.

7 to Grade of Member

Applications for Election

Applications have been received at headquarters from the following candidates for election to membership in the Institute. If the applicant has applied for direct admission to a grade higher than Associate, the grade follows immediately after the name. Any member objecting to the election of any of these candidates should so inform the national secretary before March 31, 1939, or May 31, 1939, if the applicant resides outside of the United States or Canada:

United States and Canada

Abfalter, E. J., Detroit Edison Company, Detroit, Mich.
Abrams, H. W., Argo Lamp Company, Philadelphia, Pa.
Adams, C. M., General Electric Company, Pittsfield, Mass.
Adamson, R. G., Philadelphia Electric Company, Philadelphia, Pa.
Ajello, M. F., Westinghouse Electric and Manufacturing Company, Los Angeles, Calif.
Albing, G. K., Erie Electric Motor Company, Buffalo, N. Y.
Alfers, J. B., Rural Electrification Administration, Washington, D. C.
Alsaker, A. K., Richardson-Wayland Electric Company, Pulaski, Va.
Ames, F. H., Jr., Westinghouse X-Ray Company Inc., Chicago, Ill.
Anderson, L. W., North Electric Manufacturing Company, Galion, Ohio.
Angell, A. W., Jr., General Electric Company, Schenectady, N. Y.
Ansel, R. M., Public Works Administration, Chicago, Ill.
Antrim, M. B., 414 Luzerne Avenue, West Pittston, Pa.
Applegate, C. E., Dominion Electrical Manufacturing Company, Mansfield, Ohio.
Arter, R. C., North Electric Manufacturing Company, Galion, Ohio.
Ashmead, H. E., North Electric Manufacturing Company, Galion, Ohio.
Askren, J. W., General Electric Company, York, Pa.
Athey, V. C., Wauneta Light and Power Company, Wauneta, Nebr.
Babel, P. V. R., International Business Machines Corporation, Endicott, N. Y.
Badger, B. E., United States Army Engineers, Fort Peck, Mont.
Bailey, A. D., care of K. R. Brown, Des Moines, Iowa.
Bailey, R. B., Louisiana Power and Light Company, Algiers.
Barber, W. L., 104 Sitgreaves Street, Phillipsburg, N. J.
Barton, H. J., Jr., The B-L Electric Manufacturing Company, St. Louis, Mo.
Basler, D. E., Rural Electrification Administration, Washington, D. C.
Baumhardt, G. L. R., 2027 Mars Avenue, Lakewood, Ohio.
Beach, J. M., Northwestern Bell Telephone Company, Des Moines, Iowa.
Bednarz, F. J., care of K. R. Brown, Des Moines, Iowa.
Bender, L., North Electric Manufacturing Company, Galion, Ohio.
Bennison, G. K., P. O. Box 4, Houghton, Mich.
Benowitz, H. S., 1315 Lafayette Ave., Bronx, N. Y.
Benoist, T. M., Pacific Gas and Electric Company, San Francisco, Calif.
Benz, F. D. (Member), United States Rubber Company, San Francisco, Calif.
Bergler, R. J., E. R. Squibb and Sons, Brooklyn, N. Y.
Bergseth, F. R., Allis-Chalmers Manufacturing Company, Pittsburgh, Pa.
Bevan, J. E., Roller Smith Company, Bethlehem, Pa.
Bilotta, J. E., 435 Roseville Avenue, Newark, N. J.
Bimm, E. E., Hydro Electric Power Commission of Ontario, Toronto, Canada.
Blackett, H. W., Canadian Westinghouse Company, Hamilton, Ont.
Blackhall, J. P. M., North Electric Manufacturing Company, Galion, Ohio.
Blackstone, H., San Diego Consolidated Gas and Electric Company, San Diego, Calif.
Boatwright, L. T., Jr., Company No. 2432 CCC, Mars Hill, N. C.
Bohn, A. L., 2540 Windsor Avenue, Dubuque, Iowa.
Bohn, J. T., Pittsburgh Plate Glass Company, Tarentum, Pa.
Bollone, P., Chandeysson Electric Company, St. Louis, Mo.
Bond, M. W., Mississippi State Highway Department, Jackson.
Bonds, E. R., Robert and Company, Inc., Atlanta, Ga.
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Brown, W. E., Colt's Patent Firearms Manufacturing Company, Hartford, Conn.
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Fomberstein, L., Moderne Watch Strap Company, New York, N. Y.
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Turk, R. J., Great Northern Railway Company, Spokane, Wash.
Turner, E. A., Hydro Electric Power Commission of Ontario, Niagara Falls, Canada.
Vaage, E. F. (Member), Bell Telephone Laboratories, Inc., New York, N. Y.
Vander Veen, R., Ranger Engineering Corporation, Farmingdale, N. Y.
Van Valkenburgh, P., North Electric Manufacturing Company, Galion, Ohio.
Vestal, D. M., Jr., Humble Oil and Refining Company, Baytown, Tex.
Vetersneck, J. S., 803 Valley Bank Building, Des Moines, Iowa.
Vierheller, A. P., Washington University, St. Louis, Mo.
Vinson, S. B., Ideal Electric and Manufacturing Company, Mansfield, Ohio.
Vulliet, P. O., United States Forest Service, Radio Laboratory, Portland, Ore.
Waddell, R. A., 9 Maple Road, Winthrop, Mass.
Waidelich, D. L., University of Missouri, Columbia.
Wainwright, L. F., Young and Stanley Inc., Muscatine, Iowa.
Walker, R. M., El Paso Electric Company, El Paso, Tex.
Walsh, N. B., Duquesne Light Company, Pittsburgh, Pa.
Warburton, R. W., Nevada Consolidated Copper Corporation, Ruth.
Ware, J. C., Kentucky-West Virginia Power Company, Ashland, Ky.
Washburn, M. A., Ford Bacon and Davis, Inc., New York, N. Y.
Wasson, O. G., Munn Electric Company, Ames, Iowa.
Watson, A. E., 207 East Sixth Street, Hutchinson, Kans.
Watts, J. M., Tennessee Valley Authority, Knoxville.
Weaver, J. G., North Electric Manufacturing Company, Galion, Ohio.
Weaver, R. C., A. K. Wilson Company, Oakland, Calif.
Weaver, R. T., United States Bureau of Reclamation, Denver, Colo.
Weems, J. H., Jr., Mississippi State College, State College.
Weibel, W. A., Central States Power and Light Corporation, West Union, Iowa.
Wells, H. F., Commonwealth Edison Company, Chicago, Ill.
Werts, R. W., Metropolitan Edison Company, Reading, Pa.
White, R. L., Interborough Rapid Transit Company, New York, N. Y.
Whitley, J. B., Humble Oil Company, Houston, Tex.
Wickens, S. M., 140 Mill Street, Athens, Ohio.
Wilcox, R. B., Commonwealth Ed son Company, Chicago, Ill.
Williams, A. W., Floyd County Rural Electric Co-operatives, Inc., Floydada, Tex.
Williams, G. L., Ohio Power Company, Ironton.
Williams, H. E., Knox Porcelain Corporation, Knoxville, Tenn.
Wilson, H. C., Canadian General Electric Company, Peterboro, Ont., Canada.
Wiseman, R. B., North Electric Manufacturing Company, Galion, Ohio.
Wollenweber, L. H., Indianapolis Power and Light Company, Indianapolis, Ind.
Wood, W. H., Jr., Commonwealth Edison Company, Chicago, Ill.
Wren, J. B., Jr., 1507 Wareman Avenue, Pittsburgh, Pa.
Woodburn, C. B., North Electric Manufacturing Company, Galion, Ohio.
Woodcock, R. E., Robey Manufacturing Company, East Lansing, Mich.
Woods, G. B., Ohio State University, Columbus.
Young, R. B., Jr., United States Engineers, Memphis, Tenn.
Young, R. E., Hydro Electric Power Commission of Ontario, Markham, Canada.
Yunck, F. F., Indiana & Michigan Electric Company, South Bend, Ind.
Zimmerman, H. B., 6425 12th Avenue, Kenosha, Wis.
Zimmermann, H. J., Washington University, St. Louis, Mo.

Total, United States and Canada—492

Elsewhere

Antippa, F. G., American University, Beirut, Syria.
Goldsman, J. L., J. L. Goldsman Ltd., London E.C.1, England.
Gray, L. R., General Electric Company, Rio de Janeiro, Brazil, S. A.
Karve, G. V., Tata Hydro Electric Company, Kalyan (G. I. P. Rly.), India.
Leggett, J. R., Socony-Vacuum Oil Company, Cairo, Egypt.
Macfarlane, J. W. (Member), Macfarlane Engineering Co. Ltd., Glasgow, Scotland.
Niwao, J., Hilo Electric Light Company, Hilo, Hawaii.
Pietri, A., Department of Interior, Government of Puerto Rico, Rio Piedras.
Rios, J. R., Cuban Telephone Company, Havana, Cuba.
Romeu, A. M. G., Cia Cubana De Electricidad, Havana, Cuba.
Sanchez, R. A., Cuban Mining Company, Cristo, Oriente, Cuba.
Tejada, L. H., Casilla 675, La Paz, Bolivia, South America.
Wang, S. J., A. Reyrolle & Co. Ltd., Hebburn-on-Tyne, England.
Wanner, R., Cerro de Pasco Copper Corporation, Malpaso, Peru, S. A.
White, P. E. P., Standard Telephones and Cables Ltd., London, England.

Total, elsewhere—15

Addresses Wanted

A list of members whose mail has been returned by the postal authorities is given below, with the addresses as they now appear on the Institute record. Any member knowing of corrections to these addresses will kindly communicate them at once to the office of the secretary at 33 West 39th St., New York, N. Y.

Bertolacci, R. L., 721 Brighton Road, Pittsburgh Pa.
Coleman, Irwin M., 581 Academy St., New York, N. Y.
Cory, Harold M., 270 Washington Ave., Albany, N. Y.
Ebert, Kenneth W., 776 N. Cass St., Milwaukee, Wis.
Hyman, Stanley L., 156 Medway St., Providence, R. I.
McWhorter, W. Allen, Jr., 4549 Lake Park Ave., Chicago, Ill.
Straley, Munro R., Soldier, Pa.
Van Bylevelt, J. S., 220 E. 204th St., New York, N. Y.

8 Addresses Wanted

Engineering Literature

New Books in the Societies Library

Among the new books received at the Engineering Societies Library, New York, recently are the following which have been selected because of their possible interest to the electrical engineer. Unless otherwise specified, books listed have been presented gratis by the publishers. The institute assumes no responsibility for statements made in the following outlines, information for which is taken from the preface of the book in question.

AIR NAVIGATION. By P. V. H. Weems. Second edition. New York and London, McGraw-Hill Book Company, 1938. 587 pages, illustrated, 9 by 6 inches, leather, $5.00. Covers fundamental concepts, equipment, methods and practice of navigation by dead reckoning, blind flying, and the various systems of celestial navigation.

(The) CAUSES of ECONOMIC FLUCTUATIONS. By W. I. King. New York, Ronald Press Company, 1938. 353 pages, illustrated, 8 by 6 inches, cloth, $3.50. Business depressions are considered from the economic viewpoint. The author, after describing the characteristics of depressions, discusses various misleading or inadequate explanations of their origin and offers a further explanation, a résumé of forces which influence depressions, and possible ways to forecast and minimize depression.

MODERNE MEHRGITTER-ELEKTRONENRÖHREN. Volume 2. Elektrophysikalische Grundlagen. By M. J. O. Strutt. Berlin, J. Springer, 1938. 143 pages, illustrated, 10 by 6 inches, paper, 13.50 rm. Modern multigrid electron tubes are considered from the theoretical viewpoint.

PUBLIC UTILITY RATE MAKING and the PRICE LEVEL. By E. M. Bernstein. Chapel Hill, University of North Carolina Press, 1937. 142 pages, tables, 9 by 6 inches, cloth, $2.50. The purpose of this study is to show how the rate making rule and its procedure were developed, to consider the difficulties experienced under this rule, to discuss the new methods of rate making that commissions used during the period of rapid fluctuation in prices, and to offer a reasonable solution for the problem of rate making.

STANDARDS on TRANSMITTERS and ANTENNAS, 1938. New York, Institute of Radio Engineers, 1938. 42 pages, diagrams, 9 by 6 inches, paper, $0.50. Pertinent terms are defined, graphical symbols are depicted, the factors to be considered in various methods of testing transmitters and antennas are discussed, and there is a brief section on the propagation of radio waves.

VDE-FACHBERICHTE, Volume 10, 1938 (with Inhaltskarten). Berlin-Charlottenburg 4, ETZ-Verlag. 214 pages, illustrated, 12 by 8 inches, paper, 12 rm. VDE-FACHBERICHTE Inhaltsverzeichnis der Bände 1–10 (1926–1938), 23 pages. Contains the papers presented at the 1938 annual meeting of the Verband deutscher Elektrotechniker. Sixty reports are included, discussing transmission, power lines, switchgear, machine construction, motor drives, electric heating, measurements, insulating materials, electrophysics, control and protection, telegraphy and telephony, and radio. Accompanying the book is an index to the first ten volumes of this series.

WELDED STEEL CONSTRUCTION. By R. S. Hale. New York and Chicago, Pitman Publishing Corporation, 1938. 170 pages, illustrated, 9 by 6 inches, cloth, $3.00. Aims to provide a simple, concise presentation of welded steel construction, adapted to the needs of engineers, contractors, and others familiar with structural engineering who are interested in the possibilities of welding in that field.

WINDING ALTERNATING-CURRENT MOTOR COILS. By G. A. Van Brunt and A. C. Roe. New York and London, McGraw-Hill Book Company, 1938. 281 pages, illustrated, 9 by 6 inches, cloth, $3.00. Explains and illustrates practical methods of designing, laying out, winding, and insulating the coils used in modern motors, and is intended to assist in the modernizing of older types of generators and motors and the repairing of present-day designs. A chapter is included on the properties and applications of glass-fiber insulating materials.

A.C. MOTORS of FRACTIONAL HORSEPOWER. By H. H. Jones. New York, Chemical Publishing Co., 1938. 189 pages, illustrated, 8 by 5 inches, cloth, $3.00. The working principles of fractional horsepower a-c motors are described and information is given for the construction, coil winding, testing, and repair of such motors. A special chapter is included on silencing and the suppression of radiated interference.

Die ELEKTROLYTISCHE OXYDATION des ALUMINIUMS und SEINER LEGIERUNGEN Grundlagen und Richtlinien für die praktische Durchführung der Eloxalverfahren. (Technische Fortschrittsberichte, Bd. 42, 1938). By A. Jenny. Dresden and Leipzig, Verlag von Theodor Steinkopff, 1938. 224 pages, illustrated, 9 by 6 inches, paper, 10.50 rm. A general account of current methods of protecting aluminum and its alloys from corrosion and chemical processes of protection.

FUNDAMENTAL ELECTRONICS and VACUUM TUBES. By A. L. Albert. New York, Macmillan Co., 1938. 422 pages, illustrated, 9 by 6 inches, cloth, $4.50. The material contained in this textbook is primarily for beginning study and can be described briefly as covering the following subjects: Fundamental principles of electronics and related phenomena; the electronic principles of vacuum (including gas) tubes; the use of vacuum tubes as circuit elements; photoelectric devices, cathode-ray tubes, and measurements.

Die GLEICHRICHTERSCHALTUNGEN, ihre Berechnung und Arbeitsweise. By W. Schilling. Munich and Berlin, R. Oldenbourg, 1938. 279 pages, illustrated, 10 by 7 inches, cloth, 17.50 rm. Rectifier connections are discussed comprehensively, both from the mathematical and the graphical viewpoints. Single and polyphase connections are considered under varying conditions of control, inductance, and counter-current loading. Examples, including tables and graphs, are presented.

Great Britain. Mines Dept. FIRE at DUMBRECK COLLIERY, STIRLINGSHIRE. Reports by T. Ashley and J. A. B. Horsley. London, His Majesty's Stationery Office, 1938. 27 pages, illustrated, 10 by 6 inches, paper (obtainable from British Library of Information, 270 Madison Ave., New York), $.45. Two special official reports concerning the causes of and the circumstances attending a colliery fire. The colliery is briefly described and the electrical system discussed with reference to the fire.

GRUNDZÜGE der SCHWEISSTECHNIK, Kurzgefasster Leitfaden. By T. Ricken. Berlin, J. Springer, 1938. 63 pages, illustrated, 9 by 6 inches, paper, 3.90 rm. The various methods of welding by gas, thermite, and electricity are described, including auxiliary equipment. Plans, calculations, and procedures for welding construction members are covered, as well as other special applications.

Die HOCHSPANNUNGSFREILEITUNGEN. By K. Girkmann and E. Königshofer. Vienna, Julius Springer, 1938. 504 pages, illustrated, 10 by 7 inches, cloth, 46.80 rm. An account of high-voltage overhead transmission lines, in which the structural and the electrical problems both receive treatment. Design and construction, route location, erection, and maintenance are discussed in detail.

(The) J. & P. SWITCHGEAR BOOK. By R. T. Lythall. (Third edition). London, Johnson & Phillips, Ltd., Oct. 1938. 431 pages, illustrated, 9 by 6 inches, cloth, 10s. 6d.

This handbook for the user and operator is intended as an outline of modern switchgear practice. Subjects covered include descriptions of apparatus and instruments for both indoor and outdoor switchgear, bus bars and connections, protective gear, and various problems connected with the selection, operation, and maintenance of switchgear installations.

PROBLEMS in PUBLIC UTILITY ECONOMICS and MANAGEMENT. By C. O. Ruggles. (Second edition). New York and London, McGraw-Hill Book Co., 1938. 772 pages, illustrated, 9½ by 6 inches, cloth, $6.00. Problems that arise in public utility management are presented for analysis and illustrated by actual cases. Questions considered include the economic characteristics of public utilities; their production problems; management, organization, and finance; wholesale marketing of service; retail marketing; valuation, rate making, and fair return; and regulation and management.

THEORETICAL MECHANICS, a Vectorial Treatment. By C. J. Coe. New York, Macmillan Co., 1938. 555 pages, illustrated, 9 by 6 inches, cloth, $5.00. The basic principles of vector analysis are explained and applied to classical mechanics, and through it to mathematical physics.

(The) RADIO AMATEUR'S HANDBOOK (16th Edition). 1939, by the American Radio Relay League, West Hartford, Conn. 560 pages, illustrated, 11 by 7 inches, paper, $1.00. This manual covers the amateur short-wave field. The fundamental principles and the design, construction, and operation of transmitting and receiving apparatus are described.

(The) RADIO MANUAL. By G. E. Sterling. (Third edition.) New York, D. Van Nostrand Co., 1938. 1,120 pages, illustrated, 8 by 5 inches, leather, $6.00. A textbook for those entering the radio profession as engineers, inspectors, and operators, and a reference book for those so engaged. An account of electrical fundamentals is given, together with information on equipment and systems, methods of measurement, and the rules and regulations governing radio operation.

SERVICE CHARGES in GAS and ELECTRIC RATES. By H. F. Havlik. New York, Columbia University Press, 1938. 234 pages, tables, 9 by 6 inches, cloth, $2.75. A study of the theory and practice of gas and electric rate-making, specifically concerned with the problem of service charges.

WELDING ENCYCLOPEDIA, 1938, compiled and edited by L. B. Mackenzie and H. S. Card. (Ninth edition.) Chicago, Welding Engineer Publishing Co., 696 pages, illustrated, 9 by 6 inches, leather, $5.00. Principal topics covered include the main types of welding, the most important fields of use, metals and alloys, metal spraying, rules, codes and specifications, tables and charts of engineering data, testing methods, and operator training. Company names are included with a listing of the trade names of their products.

CLAUS KRÖNCKE als Beispiel der Ingenieurausbuildung gegen Ende des 18. Jahrhunderts im Gegensatz zur heutigen Berufsausbildung de- Bauingenieurs. By W. Sbrzesny. Berlin, VDI-Verlag, 1938. 46 pages, 8 by 6 inches, paper, 250 rm. An account of the life of a ninteenth-century engineer in which special attention is given to his education for the profession; the pamphlet contributes to the history of engineering education.

DANIEL WILLARD RIDES the LINE, the Story of a Great Railroad Man. By E. Hungerford. New York, G. P. Putnam's Sons, 1938. 301 pages, illustrated, 9 by 6 inches, cloth, $3.50. Engine driver, superintendent, vice-president, president: This is the story of a man who not only left the impress of his personality on every railroad with which he was connected but also played an important part in the general railroad and labor istuation of the United States.

DAVISON'S TEXTILE CATALOGUES and BUYER'S GUIDE (1938 edition). Ridgewood, N. J., Davison Publishing Co. 366 pages, illustrated, 12 by 9 inches, cloth, free to all textile manufacturing plants, $12.00 to others. Brief catalogs of manufacturers who serve the textile industry.

DIFFERENTIAL- und INTEGRALRECHNUNG, 3 volumes. (Göschens Lehrbücherei, Bd. 24, 25, and 26). By O. Haupt and G. Aumann. Berlin, Walter de Gruyter & Co., 1938. Illustrated, 9 by 6 inches, cloth, volume 1, 196 pages, 11.20 rm.; volume 2, 168 pages, 9.80 rm.; volume 3, 183 pages, 10.60 rm. A discussion of series and real functions of one or more variables, the differential calculus of functions of one or more variables, and the theory and applications of integrals.

(An) ENGINEER'S MISCELLANY. By G. Bathe. Philadelphia, Patterson & White Co., 1938. 136 pages, illustrated, 11 by 9 inches, cloth, $4.50. Ten contributions to engineering history, illustrated by reproductions of photographs and contemporary prints.

THEORY of EQUATIONS. By J. M. Thomas. New York and London, McGraw-Hill Book Co. 1938. 211 pages, illustrated, 8 by 6 inches, cloth, $2.00. A textbook on the theory of algebraic equations for advanced undergraduate and graduate students. The treatment, though elementary, is in accord with "modern algebra."

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Papers Presented at Pacific Coast Convention, Portland, Ore., August 9–12, 1938

No.	Authors	Titles of Papers (Some Shortened)
☐ 38-43	Lightning Arrester Subcom.	*Testing and Application of Lightning Arresters
☐ 38-99	Monroe	†Electrification of the San Francisco-Oakland Bay Bridge Railway
☐ 38-100	Whelchel	*Trends in Electrical Equipment in Hydraulic Power Plants
☐ 38-101	McMillan	*Polarity Limits of the Sphere Gap
☐ 38-102	Smith	*Use of Bismuth Bridge Magnetic Fluxmeter for A-C Fields
☐ 38-103	Shuck	*A Variable-Register-Ratio Watt-Hour Meter
☐ 38-104	Thomson	*Similitude of Critical Conditions in Ferroresonant Circuits
☐ 38-105	Morris	*Application of Copper-Oxide Rectifiers
☐ 38-106	Wagner	*Self-Excitation of Induction Motors
☐ 38-107	Ager	*Determination of Induction-Motor Performance
☐ 38-108	Dalziel	*Static Power Limits of Synchronous Machines
☐ 38-109	Peterson	General Operation of Transmission Line
☐ 38-110	Cozzens & Peterson	Corona Experience on Transmission Line
☐ 38-111	Cozzens	Insulation and Lightning Protection
☐ 38-112	Lauglin	Carrier-Current Equipment
☐ 38-113	Draper	Transmission-Line Relay Protection
☐ 38-114	Skellett	*Narrow-Band Transmission System for Animated Line Images
☐ 38-115	Norwine	*Controlling Amplitude Characteristics of Telephone Signals
☐ 38-116	Gaylord	*The Pumping System of the Colorado River Aqueduct
☐ 38-117	Skilling	The Electrical Strength of Air at High Pressure
☐ 38-118	Pierce and Hamilton	*Phase-Angle Control of System Interconnections
☐ 38-119	Lyon	*The Electrostatic Unbalance of Transmission Lines

Papers Presented at Southern District Meeting, Miami, Fla., November 28–30, 1938

☐ 38-121	Kuhn	Electrolysis and Corrosion of Underground Metallic Structures
☐ 38-123	Evans	Lightning Protection Improvements for Transmission Lines
☐ 38-124	Kirkwood	Grading the Engineer's Job
☐ 38-125	Almond	Electrical Design of Pickwick Landing Project
☐ 38-126	Jones	Mulsifyre System for Extinguishing Oil Fires
☐ 38-127	Housley	Reconditioning of Insulating Oils by Activated Alumina
☐ 38-128	Stratton & Stratton	Shop Practice in the Repair of High-Voltage Bushings
☐ 38-129	George & Bessesen	Generator Damper Windings at Wilson Dam

Papers Presented at Winter Convention, New York, N. Y., January 23–27, 1939

☐ 38-122	Putman & Dann	Loading Transformers by Copper Temperature
☐ 39-4	Morgan, Brown & Schumer	Determination of Stray Load Loss in Induction Machines
☐ 39-5	Potter	Measurement of Temperature in Squirrel-Cage Induction Motors
☐ 39-6	Hellmund	The Rating of Electrical Machinery and Apparatus
☐ 39-8	Brown & Cahoon	An Amplifier-Wattmeter for Measurement of Watts and Vars
☐ 39-11	McDonald	Voltage Control of Mercury-Arc Rectifiers
☐ 39-13	Johnson	Predetermination of Temperatures in Resistance Welds
☐ 39-15	Relay Subcommittee	High-Speed Relaying Experience and Practise
☐ 39-17	Lynn	Effects of Temperature on Rotating Electrical Machinery
☐ 39-18	Rutherford	The Rating and Application of Motors for Refrigeration
☐ 39-19	AIEE & EEI Committees	Bus Protection
☐ 39-21	Konn & Craton	Performance of the 3600-Hp New Haven Electric Locomotives
☐ 39-22	Kotterman	The Magnesium Copper Sulphide Rectifier Battery Charger
☐ 39-23	Seletzky & Zucker	Sensitivity of the Four-Arm Bridge
☐ 39-24	DeBellis	Modernization of Switch House Design
☐ 39-26	Strang & Hanna	Modernization of Switch House Design
☐ 39-27	Harder	Relay Protection of Pennsylvania Railroad Electrification
☐ 39-28	Caruthers	Copper-Oxide Modulators in Carrier Telephone Systems
☐ 39-31	Smith, Sonnemann & Dodds	Applying Ratio Differential Relays for Bus Protection
☐ 39-32	Stitcher & Thomas	Effect of Corona Discharge on Liquid Dielectrics
☐ 39-33	Kent & Blye	Inductive Co-ordination With Series Sodium Lighting Circuits
☐ 39-34	Ludwig & Grissinger	A New High-Capacity Air Circuit Breaker
☐ 39-35	Dickinson	"De-Ion" Air Circuit Breaker for Central-Station Service
☐ 39-36	MacNeill & Hill	Multiple-Grid Breakers for High-Voltage Service
☐ 39-39	Cox & Jones	Ignitrons for the Transportation Industry
☐ 39-40	Gray & Breyer	An Electronic Control Circuit for Resistance Welders
☐ 39-41	Ingram	Cold-Cathode Gas-Filled Tubes as Circuit Elements
☐ 39-42	Cassidy & Mosteller	Continuous Processing for Automobile Tire Fabrics
☐ 39-43	Smith	Electric Drives for Supercalenders in Paper Mills
☐ 39-45	Chu & Barrow	Electromagnetic Horn Design
☐ 39-46	Byrne	Polyphase Broadcasting
☐ 39-47	Dellinger	The Role of the Ionosphere in Radio Wave Propagation
☐ 39-49	Peterson	Power System Voltage Recovery Characteristics
☐ 39-52	Clarke, Crary & Peterson	Overvoltages During Power System Faults
☐ 39-53	Kendall & Affel	A 12-Channel Carrier Telephone System for Open-Wire Lines
☐ 39-54	Lawton	The Submarine Cable Plow
☐ 39-55	Nelson	The Submarine Cable Depthometer
☐ 39-56	Sorber & Smith	Remote Control Tollboard
☐ 39-57	Scudder & Reynolds	Crossbar Dial Telephone Switching System
☐ 39-58	Corney & Edson	Modernization of L Street Station Switch House
☐ 39-59	Hildebrand	Duty Cycles and Motor Rating
☐ 39-65	Roby	Simplified Precision Resistance Welder Control
☐ 39-66	Wright	Power Supply for Single-Phase Resistance Welders
☐ 39-67	Holslag	The A-C Arc Progresses
☐ 39-68	Kidder	Notes on Emergency Ratings
☐ 39-69	Thomas	Economical Loading of Underground High-Voltage Cables
☐ 39-71	Shanklin	Low Gas Pressure Cable
☐ 39-72	Lincoln & Sprole	Demand Meter Time Periods
☐ 39-73	Keinath	An Automatic A-C Potentiometer and Applications to Testing
☐ 39-74	Green	Aluminum-Nickel-Cobalt Brake Magnets for Watt-Hour Meters

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* These papers have been published in the Transactions section of Electrical Engineering.
† This paper has been published in the 1938 AIEE Transactions volume.